APPENDIX A

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Provisional Patent Application

for

KNOWLEDGE MANAGEMENT AND INFORMATION DEPLOYMENT SOFTWARE SYSTEM

INVENTORS

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Introduction

1.1 Purpose

This document discloses software system requirements for a preferred embodiment of the Interneer software system.

1.2 Scope

This document comprises the software requirements specification (SRS) for the Interneer product.

1.3 Definitions, Acronyms, and Abbreviations

Annotate	Ability to add a single unit of information to another existing unit of information
Criticality	Relative importance of individual requirements.
Codify	Organize
Engineer	Mechanical Engineers, Manufacturing Engineers, Aerospace Engineers, Civil Engineers, Structural Engineers, Engineering Managers, Project Coordinators, and Technicians.
Embedded Knowledge	Knowledge embedded in the processes and products that people create.
Embodied Knowledge	Knowledge embodied in people and social networks.
Identifier	Unique identification of each requirement.
Information	Text, charts, equations, figures, tables etc. available in a tangible form e.g. electronic, print etc.
Knowledge	Information with significant human value added.
Open Knowledge Environment	Core Phenom knowledge base.
Phenom	Interneer "Internet Aided Engineering" product suite.
Rationale	Reason for requirement. (Should also serve to preserve context and assumptions)
Responsible Individual	Responsible for performing impact analysis should requirement change.
Source Document	Provides link between source of requirement (e.g. end user specifications) and requirement.
SRS	Software Requirement Specification
Tacit Knowledge	Embedded and Embodied Knowledge.
Taxonomy	A division of files into ordered groups or categories -- defines how data is stored and accessed in the database
Unit	Single instance of information.
URL	One or more units.
User	Engineers and Vendors.
Verification	Method to be used to demonstrate requirement was achieved.

Method	(Analysis, test, inspection, or demonstration)
Vendor	Procurement Agents, Parts Suppliers, Project Coordinators, Engineering Managers, Manufacturers, and Engineering Consultants.
Workflow	Definition of a sequence of steps through URLs.

1.4 References

1.4.1 XML

www.xml.org

1.4.2 Architecture, Engineering, and Construction XML Working Group

www.aecXML.org

1.4.3 The Windows Interface Guidelines for Software Design

Microsoft Corporation
One Microsoft Way
Redmond, Washington 98052-6399

2 General Description

2.1 Product Perspective

Phenom will implement an online product suite initially serving the design and analysis needs of the mechanical engineering community. From product concept to final procurement Phenom's platform will cut engineering costs and product time to market by delivering Internet Aided Engineering software tools. These tools, and all the functionality contained herein, although especially useful in engineering, can be broadly applied to other industries with the same affects. For the purpose of simplicity, the rest of this document is written with the specific application of engineering in mind.

This online solution will provide access to essential mechanical engineering information, guidelines, and procurement resources and will facilitate the capture and leveraging of internally generated engineering knowledge. Phenom's revenue will flow from software license fees, vendor commissions, and ASP offerings.

Through a unique combination of online knowledge, workflow, and community management, Phenom will dramatically increase both efficiency and effectiveness. As a result, the process of mechanical engineering (and later processes in other information intensive industries) will become far more cost effective, while simultaneously benefiting from an overall increase in quality.

2.2 Product Functions

The Phenom product will address the following areas of functionality:

- Knowledge Management,
- Collaboration & Project Management, and
- Community management.

2.2.1 Knowledge Management

Information, in combination with an understanding of how to apply that information to the solution of a real-world problem, is generally recognized as being knowledge.

Conversely, in the particular case of Phenom, information is knowledge that has been reduced to some tangible format. In its simplest form, information relevant to Phenom may be in printed or electronic format. This information contains a great deal of embedded knowledge – knowledge not explicitly written out, but that can be extracted with careful consideration and some reading between the lines. Additionally, users will be able to combine their own understanding and insights with their interaction with the information to engender embodied knowledge.

The ability to capture, organize, and navigate information is an essential component of the Phenom "Internet Aided Engineering" solution (later extended as mentioned above – for example "Internet Aided Accounting", "Internet Aided Pharmaceuticals", "Internet Aided Genetics", etc.). Some of the major benefits of this class of functionality include:

- **Facilitating the use of Best Practices**

  Provides engineers with hints, insights, and starting points in their design and analysis activities. These best practices come from a number of sources including books, personal journals, websites, and experienced engineers. Given that this knowledge comes from disparate sources, there exists a need for their accumulation and intelligent distribution on a common platform. Phenom is that platform.

  This knowledge can simply be information, or it can be in a less tangible form such as embodied or embedded knowledge. In any case, Phenom will provide a means of capturing and navigating through the knowledge in an intelligent manner, taking advantage of the way it is captured and codified. With this product, engineers will no longer need to spend enormous amounts of time searching for their answers or reinventing the wheel.

- **Leveraging Adaptability**

  As technology advances, new knowledge is produced and existing knowledge sometimes becomes obsolete. This continues to be a source of great challenge to technical publishers. The Internet, to a large extent, relieves this shortcoming by allowing for real time adaptation. The Phenom databases will be continually updated and expanded to reflect the most current advances and best practices in engineering – updates and expansions will come both from Interneer staff members and Interneer customers. Because of this, companies using Phenom will have a significant advantage over traditional technical publishers. Also, as more and more content is added, Interneer gains economies of scale and hence erects additional barriers to entry for competing firms.

- **Providing Focused Visibility into Intangible Assets**

  Engineering firms aren't always capable of seeing their own weaknesses. By tracking

their engineers' activities, engineering managers can determine areas of strength and weakness in their firm's knowledge resources. This provides the ability for them to staff up in areas they feel they need to improve, along with invaluable insight to how their engineers work.

- **Virtual Workspace**

  Phenom provides access to powerful software tools and information wherever a user can connect to the Internet. Not only will engineers have a virtual briefcase full of their personal engineering knowledge for life, but also teams of engineers can interact and share critical knowledge independent of geographic location.

Just as the ability to manage information is a cornerstone of the Phenom product, the need to manage tacit knowledge is absolutely essential. The value of tacit knowledge is often orders of magnitude greater than that of information.

Not only is the process of identification and capture of tacit knowledge notoriously difficult, but it can be quantified only by the "producer" of that knowledge. Therefore, it is mandatory that the Phenom product provides a means by which an engineer can identify and capture their tacit knowledge.

Although captured information may encompass "dynamic" knowledge processes, such as an interactive equation, there's also a need to associate these incremental business processes into larger workflows. It's in the animation of these "captured" workflows that Phenom will deliver its greatest gains in productivity and quality.

2.2.1.1 Capture

2.2.1.1.1 Information

In order to work with information that exists in a tangible format (i.e. electronic, print etc.), it will be necessary to provide a means for the identification and capture of it. Properly captured, the information becomes much easier to codify. Once properly codified, the information is transformed into a powerful tool that can be leveraged to suit the needs of engineers. The capturing of information includes a review process, which filters out unusable information.

2.2.1.1.2 Tacit Knowledge

2.2.1.1.2.1 Annotation

Annotations are units of information attached to other existing units of information. They support the ability to capture and codify tacit knowledge. Knowledge captured through annotation becomes information. This knowledge, which is embodied in engineers' minds and embedded in the processes they use, is immediately captured as they use Phenom. By capturing and codifying tacit knowledge in annotations form, Phenom ensures that knowledge that was once hard to access, is now well leveraged and easily accessible.

2.2.1.1.2.2 Workflow

Although annotations allow for the capture of tacit knowledge, there is a greater need to capture more complex knowledge in the form of workflows. A workflow describes a series of associated steps that define a guiding process that explains how to conduct a task. This form of tacit knowledge is very important to capture and leverage since it usually represents guidelines and

rules of thumbs: essentially shortcuts that experienced engineers take to save time in their daily work. While capturing a workflow, a user is able to define an entire engineering design process. Once it is captured, the knowledge becomes information that is now codified or organized. A review is also included which ensures only filtered knowledge is allowed.

2.2.1.2 Codify

2.2.1.2.1 Information

All captured information must be codified and thus facilitates the easy access to and interaction with best practices. This is the process by which a structure of relationships between information and information identifiers that locate the information are established. This "information architecture" or taxonomy will support and simplify the interaction with, and access to, captured information since it provides the blueprint for the information structure.

2.2.1.2.2 Tacit Knowledge

2.2.1.2.2.1 Annotation

All information captured via annotation is automatically codified since it is captured in context: The engineer annotates when they are interacting with information on Phenom.

2.2.1.2.2.2 Workflow

Workflow processes will need to be codified properly and associated with the information taxonomy in order to reap the benefits of quick and easy access.

2.2.1.3 Leverage

2.2.1.3.1 Information

The ability to leverage captured and codified knowledge is the main benefit in knowledge management, leading to tremendous timesaving, increased efficiency and reduced frustration. The leveraging of information is conducted by using the Phenom technology to optimize access and interaction with codified information.

2.2.1.3.2 Tacit Knowledge

2.2.1.3.2.1 Annotation

Annotations are tightly coupled with their associated captured information. Navigation and leverage of this class of information will differ from typical captured information in the sense that it will not be accessible via the taxonomy, but through its relationship to the former. Annotations are optimally leveraged through Phenom since they are presented to the right user, who is interested in the captured information, at the right time, when they are interacting with the captured information.

2.2.1.3.2.2 Workflow

Animating the captured workflow is an important way to facilitate leveraging of knowledge after capturing it. It essentially provides a snapshot view into the experienced engineer's mind that created the workflow. By providing this functionality, Phenom then ensures an effective technique of leveraging tacit knowledge.

2.2.1.3.2.2.1 Animation

This is the process of making steps within a workflow interactive. The ability to animate a workflow provides an optimal means to leverage tacit knowledge.

2.2.1.3.2.2.2 eJournal

eJournal provides the ability to bookmark a work step of a workflow at any discrete moment in time and allows the engineer to keep track of their work in real time as they interact with the workflow. Also, the eJournal allows the engineer to restore their bookmarked work step at any

moment in time and allow the information to be transferred to other parts of a workflow. The eJournal saves engineers time by not requiring them to repeat work steps.

2.2.2 Community Management

The Phenom product leverages the unique ability of the Internet to facilitate communication between large and disparate user communities. It will be necessary to define and manage a multiple communities and combinations of communities. In particular, it will be necessary to define and manage a "core" community, which shares all system resources together with subsets of that community that will share and possibly "publish" private resources to the larger community.

2.2.2.1 Define a Community

It will be necessary to be able to create and modify communities, which may contain valid registered users of the system. The ability to add or remove members to or from a community will be required.

2.2.2.2 Publish

Members of an individual community will be able to publish content to their respective communities. That content will remain private to the "owning" community. If desired, an administrator of a community may choose to publish content to one or more additional communities, including the core Phenom community. Ownership will remain with the originating community.

2.2.3 Collaboration, Procurement & Project Management

Collaboration and project management together encompass a large area of functionality within the Phenom software.

2.2.3.1 Collaboration

Phenom will allow online collaboration between users in different departments in an organization, cities or countries. Collaboration is in the form of real time information sharing and online meetings.

2.2.3.2 Procurement

Engineers on Phenom will have the ability to connect with vendors and products at the end of a full design process. The products presented will be based on the designs they conduct. The connection will allow engineers to purchase the desired product online or to collaborate with them.

2.2.3.3 Project Management

Managing projects on the Phenom platform is fundamental in making the design process efficient. Users can organize projects based on teams, goals, and assemblies with full access control, hence providing a virtual platform for users to work collaboratively online.

3.1 External Requirements

3.1.1 Internet Enabled

3.1.4 Interface Integrity

3.2 Functional Requirements – Knowledge Management

3.2.1 Capture
3.2.1.1 Information
3.2.1.2 Tacit Knowledge
3.2.1.3 Annotation
3.2.2 Codify
3.2.3 Leverage
3.2.3.1 Search – Without Taxonomy
3.2.3.2 Search – Within Taxonomy
3.2.3.3 Annotation
3.2.3.4 Expert Guidance System

3.3 Content Requirements

3.3.1 Industry Standard Content
3.3.1.1 Information
3.3.1.2 Tacit Knowledge

3.5 Functional Requirements – General

3.5.1 Analysis
3.5.1.1 Solve equations on the site
3.5.1.2 Solve for any variable in equation
3.5.1.3 Chart relationship between two variables in equation
3.5.1.4 Chart relationship between three variables in equation
3.5.7 Online Journal
3.5.7.1 Automatic Storage
3.5.7.2 Journal Data Encrypted
3.5.7.3 Journal is Searchable

2.3 User Characteristics

The anticipated Phenom user community can be divided into the following general groups:

- Mechanical Engineer
- System Administrator

It is assumed that a mechanical engineer will have completed all educational requirements of the profession, in addition to possessing a high degree of computer literacy.

2.4 General Constraints

The Interneer product must be able to exchange information with external systems via XML, and AECXML. As a result, it will be subject to any and all limitations inherent in each of these protocols.

The Interneer product must conform to all applicable industry standards of system security and data integrity.

2.5 *Assumptions and Dependencies*

It is assumed that current market trends will persist throughout the development and deployment stages. As envisioned, this will be an Application Service Provider (ASP) product, deployed and accessible only over the Internet and through an Internet browser.

3 Specific Requirements

3.1 *External Requirements*

3.1.1 *Internet Enabled*

Identifier	
Description	Must be accessible through the World Wide Web and across and intranet.
Rationale	Interneer is relying on the interactivity and accessibility of the Internet to provide up-to-date and real-time resources for engineers. Also some customers may prefer an intranet solution.

3.1.2 *XML Interface*

Identifier	
Description	System Integration must be using XML and AECXML.
Rationale	Adopting an industry standard interface protocol will: 1. Minimize the effort required to implement a solution, 2. Maximize the ability to interface with external systems, 3. Facilitate communication with other vendors via a complete and detailed specification, and 4. Promote the implementation of a robust solution based on the design work of accepted industry knowledge experts.

3.1.3 *Industry Standard Data Definitions*

Identifier	
Description	Information exchanged between Phenom and external systems must adhere to industry standards. In particular, identifiers for parts and/or assemblies must conform to industry standards.
Rationale	Adopting an industry standard identifiers will: 1. Minimize the effort required to implement a solution, 2. Maximize the ability to interface with external systems, 3. Facilitate communication with other vendors via a complete and detailed specification, and 4. Promote the implementation of a robust solution based on the design work of accepted industry knowledge experts.

3.1.4 *Interface Integrity*

Identifier	
Description	Information crossing the system boundary must be subject to the same business rules (including access control and auditing) as internal methods of information exchange.
Rationale	By definition, if multiple implementations of a business process are attempting to access or modify a common set of data according to

	the same business rules, the results cannot be guaranteed to be the same. Even if the data is skewed only slightly, the cumulative effect can be disastrous. In addition to the obvious increase in data integrity, the corresponding reduction in the amount of resources required to properly validate system functionality absolutely dictates this requirement.

3.2 Functional Requirements – Knowledge Management

3.2.1 Capture

3.2.1.1 Information

Identifier	
Description	Must be able to identify and capture information in a manner that facilitates the ability to then codify and leverage it. In order to work with information, it will be necessary to provide a means for the identification and capture of it. Since this type of knowledge can be found in many formats and configurations, responsibility for the identification and parsing of relevant information will lie beyond the boundary of the Phenom product. Capture will accommodate electronic media only.

3.2.1.1.1 Navigate

3.2.1.1.1.1 There must be a mechanism by which candidate information may be located.

3.2.1.1.2 Identify

3.2.1.1.2.1 There must be a means by which candidate information may be uniquely identified.

3.2.1.1.3 Capture

3.2.1.1.3.1 Information that has been located and uniquely identified must be brought within the Phenom system boundary.

Information can be brought within the system boundary by value or by reference. If information is to be accesses by reference, then a means by which it can be located must be captured (i.e. URL, user name and password, etc.).

3.2.1.1.3.2 Any member of the targeted user community must be able to capture information in a consistent and reliable manner.

Through the use of a controlled user interface, information will be entered into the system according to predefined "expert templates" designed to implement rules of format, suitability of content, and context.

It is critical that a simple and intuitive class of template functionality be defined and implemented.

3.2.1.1.3.3 All information must be captured into a Phenom container.

All information within the Phenom system will be stored within a uniquely identifiable instance of a container.

3.2.1.1.3.4 Information may contain other information.

Each instance of information may, in turn, contain one or more instances of information.

3.2.1.1.4 Submission

3.2.1.1.4.1 All information captured into the Phenom system must be submitted to a review process.

3.2.1.1.5 Review Process

3.2.1.1.5.1 It is mandatory that an editorial review and publication process be applied to all captured candidate information.
This is critical to ensure that the overall quality and fidelity of the knowledge base remains high.

3.2.1.1.6 Community

3.2.1.1.6.1 Captured information belongs to (is owned by) one user and, optionally, by one or more user communities (to which the user must belong).

3.2.1.1.6.2 By default, information belongs to (is owned by) the user who captured it, and not their user community.
Users must have the ability to capture their expertise and publish it to other users within their user community (i.e. other members of the user's company, business unit, organization, etc.).

3.2.1.1.6.3 Captured information must be private, secure, and protected.
Interneer must guarantee privacy and protection of all captured trade secrets and Intellectual Property.

3.2.1.1.6.4 Private information (i.e. not belonging to the core Phenom user community) may be submitted to Interneer for review and possible publication to the core Phenom user community.
By allowing users to contribute to the core knowledge base, Interneer will grow organically and become an Open Knowledge Environment.

3.2.1.1.7 Branding

3.2.1.1.7.1 Information submitted for publication to the core Phenom knowledge base, if approved, will be branded (i.e. information will be "tagged" - corporate logo, etc. - to identify the submitting user community – company, organization, etc.).
User community exposure (i.e. contributing company, organization, etc.) will act as an incentive to the submission process.

3.2.1.1.8 Scalability and Reliability

3.2.1.1.8.1 Interneer must implement an infrastructure capable of handling the anticipated response and storage demands of its targeted customers.
This is critical to ensure scalability and reliability.

3.2.1.2 Tacit Knowledge

Identifier	
Description	Must support the capture of tacit knowledge. Provides the ability to capture embedded and embodied knowledge in the form of a workflow.
Rationale	The ability to capture expertise – which exists in the form of tacit knowledge – completes the set of knowledge capture functionality.

3.2.1.2.1 Navigate

3.2.1.2.1.1 There must be a mechanism by which instances of captured information may be located.

The capture of tacit knowledge is essentially the capture of a work process that relies upon one or more instances of information. By establishing an association between these instances of information, it's possible to define a coherent sequence of steps to be traversed in the process of solving an engineering problem.

3.2.1.2.2 Identify

3.2.1.2.2.1 There must be a means by which an association of instances of captured information may be uniquely identified.

Just as instances of information must be uniquely identified, so must their associations.

3.2.1.2.3 Capture

3.2.1.2.3.1 Instances of captured information must be associated, and the associations must be brought within the Phenom system boundary.

Capturing tacit knowledge will require the recording of a sequence of instances of captured information. There is no requirement that the instances be unique. Nor is there any implied dependency, outside of those defined by the association.

It will be necessary to define zero or more elements of an instance of information whose values must be persisted and associated with one of the steps in the recorded process.

Inversely, it will be necessary to define zero or more elements of an instance of information whose value must be derived from a previously persisted value. Obviously, the definition of these elements must be unique within a captured process.

3.2.1.2.4 Submission

3.2.1.2.4.1 Same requirements as information capture.

3.2.1.2.5 Review Process

3.2.1.2.5.1 Same requirements as information capture.

3.2.1.2.6 Community

3.2.1.2.6.1 Same requirements as information capture.

3.2.1.2.7 Branding

3.2.1.2.7.1 Same requirements as information capture.

3.2.1.2.8 Scalability and Reliability

3.2.1.2.8.1 Same requirements as information capture.

3.2.1.3 Annotation

Identifier	
Description	Users must be able to create, save and edit annotations and link them to instances of information (i.e. text, graphics, equations, etc.) while using the product. Depending on ownership, annotations will be accessible via the original author, other members of the author's community, or by the core Phenom community.
Rationale	This will be an early version of a true knowledge capture process.

3.2.1.3.1 Create

3.2.1.3.1.1 Any user may create and attach annotations to any instance of information (e.g. text, files, graphics etc.). However, the creation request must pass through a review process before being published.

3.2.1.3.2 Modify

3.2.1.3.2.1 Any user may modify any existing annotation (must pass through review process before being published).

3.2.1.3.3 Submit

3.2.1.3.3.1 All annotations will be routed through an "editorial" process.
As with all "published" information, it will be necessary to provide a mechanism for reviewing submissions. This process will be necessary for both user submissions to a community within their own organization, or to the Phenom community at large.

3.2.1.3.4 Review

3.2.1.3.4.1 If an annotation is to be made available to all other members of the author's community, or to the members of the core Phenom community, then the author must submit newly created or modified annotations to an editorial review process.
This is important to ensure the validity and suitability of data and to discourage users from submitting unwanted information.

3.2.2 Codify

Identifier	
Description	Must be able to codify captured information and tacit knowledge.
Rationale	Captured knowledge in the form of information and processes cannot be leveraged without the ability to efficiently and effectively locate and use relevant information in a timely manner.

3.2.2.1.1 Taxonomy

3.2.2.1.1.1 Keyword
Implements a unique identifier.
Used to identify unique instances of captured knowledge (i.e. captured information and tacit knowledge).
Used to identify unique instances of categories.

3.2.2.1.1.2 Category
Identified by a single keyword.
Keyword is not unique to an instance of a category.

3.2.2.1.1.3 Target
Defines a coherent set of captured knowledge (i.e. captured information or tacit knowledge) via a set of keyword identifiers.
Set of identifying keywords is not unique to an instance of a target.
Captured information can be of many types (i.e. XML, text, equation, database entry, etc.).
Contains all information required to locate and access the associated captured knowledge (i.e. URL, key index into a database, usernames and passwords, etc.).
Derives context via its association with one or more links.
May contain other targets.

3.2.2.1.1.4 Link
Identified by a keyword.

Associates categories to categories, and categories to targets.
Implements a hierarchy of parent/child relationships between associated endpoints.

3.2.2.1.1.5 Search

Search will be against keyword domain.
For each target whose set of keywords contains the search keyword, all chains of links and categories will be traversed in order to reach one or more category endpoints.
Category endpoints will implement virtual roots of a dynamically generated hierarchy of categories.
Navigation of the category chains will implement a hierarchical search method.

3.2.2.1.1.6 Network model of relationships

Not a tree – therefore, no single unique root.
Categories and targets may be associated with one or more other instances of categories or targets.
No circular references are allowed (links imply a limitation on the traversing of network paths based on a parent/child relationship).

3.2.2.1.1.7 Create

It will be necessary to provide a means to define and create taxonomy. In particular, the creation of categories and links will implement the taxonomy.

3.2.2.1.2 Navigate

3.2.2.1.2.1 It will be necessary to navigate captured knowledge (i.e. information and processes) for the purpose of assigning them to taxonomy.

3.2.2.1.3 Identify

3.2.2.1.3.1 It will be necessary to identify instances of captured knowledge via taxonomy.

There must be a means for associating instances of captured knowledge to entries within taxonomy.

3.2.2.1.4 Review Process

3.2.2.1.4.1 It is mandatory that an editorial review and publication process be applied to all potential associations between instances of captured knowledge with taxonomy.

This is critical to ensure that the overall quality and fidelity of the knowledge base remains high.

3.2.3 Leverage

3.2.3.1 Search – Without Taxonomy

Identifier	
Description	Must allow users to search for keywords, sentences, acronyms and their related meanings, definitions and terms. This applies to all searchable information.
Rationale	This is important for general searches, including material from manufacturers, vendors, etc.

3.2.3.1.1 Semantic

3.2.3.1.1.1 Must be able to respond to natural language queries.

Must be able to structure a query in natural language.

3.2.3.1.1.2 Must be able to understand relationships between different words.
Must be able to understand semantics of query.

3.2.3.1.2 Part

3.2.3.1.2.1 Results of search must be context sensitive.
Must be able to provide results that are relevant only to the part or assembly being designed.

3.2.3.1.2.2 Vendor search results must be able to be grouped according to pre-defined categories.
Search results will depend on user selected grouping criteria, and formatted accordingly.

3.2.3.1.2.3 Search will provide results for parts that match only a predetermined percentage of features specified.
User will define minimum of required features (or a percentage of total features).

3.2.3.1.3 Keyword

3.2.3.1.3.1 Allows keyword search of content.

3.2.3.1.4 Vendor

3.2.3.1.4.1 Allows name, location, and industry search for vendors.

3.2.3.1.5 Journal

3.2.3.1.5.1 Allows keyword search of contents of Online Journal.

3.2.3.1.6 Data

3.2.3.1.6.1 Allows search through charts, graphs, figures, equations and tables.

3.2.3.2 Search – Within Taxonomy

Identifier	
Description	Must allow users to search knowledge base via taxonomy.
Rationale	This is the most powerful method of leveraging captured knowledge.

3.2.3.2.1 Navigate

3.2.3.2.1.1 Must be able to navigate to instances of captured knowledge.
See Codify section above for a description of search.

3.2.3.2.2 Render

3.2.3.2.2.1 Target containers of information must be rendered according to an associated format.
At the time of capture, an "expert template" will, among other functions (such as data validation, etc.) establish a "style" by which the captured information will be rendered (captured information may contain additional captured information).

3.2.3.3 Annotation

Identifier	
Description	Must be able to view and maintain annotations to captured knowledge.
Rationale	Annotations are an established method of insuring the completeness, freshness, and accuracy of captured knowledge.

3.2.3.3.1 Navigate

3.2.3.3.1.1 It will be necessary to provide a means by which a user may navigate annotations to an instance of captured knowledge.

3.2.3.3.2 Maintain

3.2.3.3.2.1 Maintenance will be via capture functionality.

3.2.3.4 Expert Guidance System

Identifier	
Description	Based on the "animation" of captured tacit knowledge, the Expert Guidance System must guide and assist engineers through problem solving activities.
Rationale	This system is what will distinguish Phenom from simply placing a book online and conducting a keyword search. Proper implementation of the Guidance System will lead to more efficient use of time, in combination with reduced errors.

3.2.3.4.1 Usability

3.2.3.4.1.1 Engineers of all skill levels must be able to interact with the Guidance System in order to arrive at the answer they seek.
It's critical that the Phenom system gather as much information as possible, in an efficient manner, such that the best solution may be found with the minimum investment of time and effort.

3.2.3.4.2 Guidance

3.2.3.4.2.1 Engineers must be able to find the best solution to their problem.
It will be necessary to always lead an engineer to a solution.

3.2.3.4.3 Wizard

3.2.3.4.3.1 The Guidance System must be able to suggest alternatives and possibilities that engineers might have overlooked in solving a specific design problem.
This functionality serves the purpose of an interactive expert review of their design solution.

3.3 Content Requirements

3.3.1 Industry Standard Content

3.3.1.1 Information

Identifier	
Description	Must capture most widely used engineering information (i.e. that information which is currently available in popular engineering handbooks, such as the Machinery's Handbook).
Rationale	Phenom will apply the 80-20 rule providing 20% of the information (available in popular handbooks) used by 80% of the engineers

3.3.1.1.1 Limited in Scope

3.3.1.1.1.1 Interneer will provide information contained in popular engineering handbooks, which represents the most widely used information by engineers.
Interneer will not attempt to capture all of the engineering knowledge in the world.

3.3.1.1.2 Variety of Content

3.3.1.1.2.1 Interneer will provide a variety of types of information in a variety of electronic forms, catering to a variety of customer demographics (e.g. tutorials on engineering, tools for brainstorming, tools for mechanism designs, multiple engineering examples, etc.).
These various resources will provide multiple benefits for users.

3.3.1.2 Tacit Knowledge

Identifier	
Description	Must capture industry standard tacit knowledge.
Rationale	Leverage prior work of industry experts.

3.3.1.2.1 Specific Solutions to Broad Set of Problems

3.3.1.2.1.1 Although individual guidance system solutions will be problem specific, the scope of solutions will span a large set of common engineering problems.
Phenom will apply the 80-20 rule for content to ensure that 80% of client engineers are served by 20% of the engineering problems and solutions.

3.3.1.2.2 Engineering Guidelines

3.3.1.2.2.1 The guidance system must be able to solve established engineering problems using established engineering guidelines gathered from books and experts.
Phenom will ensure that guidelines gathered from experts and books will be of value to engineers.

3.4 Functional Requirements – Collaboration and Project Management

3.4.1 Collaborative

Identifier	
Description	Must allow collaboration and exchange of information and work.
Rationale	In order to ensure the most efficient work and design environment, collaboration and information exchange is necessary.
Type	Mandatory

3.4.1.1 Persistent Context

3.4.1.1.1 Engineers need to be able to start collaboration, stop at any time and for as long as needed and then pick up where they left off without any loss of information.
This is important to ensure efficiency.

3.4.1.2 Real time whiteboard/pegboard

3.4.1.2.1 Engineers have to be able to append documents in a collaboration session and be able to edit, modify, delete, save etc.
This is important for productivity.

3.4.1.3 Chat

3.4.1.3.1 Engineers need the ability to communicate while collaborating.

3.4.1.4 Real time shared application view port

3.4.1.4.1 Multiple engineers need to be able to view the online documents and edit privileges should be available to each engineer at different times pending access privileges.

Engineers will need to share and edit project information regularly.

3.4.1.5 Use multiple collaborative tools

3.4.1.5.1 Engineers will need to run some simple tools regularly when collaborating, e.g. online calculator, calendar, etc.
This will improve productivity.

3.4.1.6 Record Session

3.4.1.6.1 A detailed log of all the events, content, participants, times, logoff and logon times and others are essential to ensure proper documentation and knowledge management. Engineers often refer to previous meeting notes.

3.4.1.7 Among Engineers

3.4.1.7.1 Engineers need the ability to share project data and information in real time. The data is in the form of Interneer pages being viewed, files stored, journal entries, and expertise built.
Engineers will need to share project information regularly.

3.4.1.8 Between Engineers and Vendors

3.4.1.8.1 Engineers need the ability to share project data and information in real time with Vendors to ensure proper design. The data is in the form of Interneer pages being viewed, files stored, journal entries, and expertise built.
Engineers will need to tap into vendor expertise regularly.

3.4.1.9 Between Engineers and their Customers

3.4.1.9.1 Engineers need the ability to share project data and information in real time with their Customers. The data is in the form of Interneer pages being viewed, files stored, journal entries, and expertise built.
Engineers will need to obtain Customer approval regularly.

3.4.2 Project Planning/Tracking/Oversight

Identifier	
Description	Must provide simple project planning, tracking and oversight functionalities
Rationale	Engineers will use Interneer to work collaboratively on projects

3.4.2.1 Milestones creation/modification

3.4.2.1.1 Engineers must be able to create simple tasks along with completion dates requirements.

3.4.2.2 Milestones tracking

3.4.2.2.1 Engineers must be able to review project progress and track completed tasks.

3.4.3 Document Management

Identifier	
Description	Must provide means for administering files, user and document control.
Rationale	This is important for collaborative work on projects

3.4.3.1 Approval mechanism

3.4.3.1.1 Ability to install final approval mechanism on document control is necessary. These are tools that empower the owner of the files

3.4.3.2 Control/track modifications

3.4.3.2.1 Need to track versions of files and users who modified them. These are tools that empower the owner of the files

3.4.3.3 Control/track user access to files/folders/journal

3.4.3.3.1 Need to track users and their access to files, folders and the journal. These are tools that empower the owner of the files.

3.4.3.4 Upload/download changes to files only

3.4.3.4.1 System must save bandwidth by only transferring changes to a file. This is important for cost and efficiency.

3.5 Functional Requirements – General

3.5.1 Analysis

Identifier	
Description	Allows analysis of data, charts and equations in real time.
Rationale	The Phenom work environment must allow analyses in order to provide a complete solution.

3.5.1.1 Solve equations on the site

3.5.1.1.1 Engineers must be able to enter numbers into algebraic equations or figures (if applicable) and solve them online. By solving, it is implied that engineers will obtain a numeric value response or chart in return for entering numeric data into a form.
This is part of a series of tools designed to improve engineers' efficiency.

3.5.1.2 Solve for any variable in equation

3.5.1.2.1 Engineers must be able to leave any variable blank and Phenom must be able to know which one is blank and then solve for it.
This is part of a series of tools designed to improve engineers' efficiency.

3.5.1.3 Chart relationship between two variables in equation

3.5.1.3.1 Engineers must be able to leave any two variables blank and then view a plot that compares their relationship to each other.
This is part of a series of tools designed to improve engineers' efficiency.

3.5.1.4 Chart relationship between three variables in equation

3.5.1.4.1 Engineers must be able to leave any three variables blank and then view a plot that compares their relationship to each other.
This is part of a series of tools designed to improve engineers' efficiency.

3.5.1.5 Interpolate any data point on a table

3.5.1.5.1 Engineers must be able to view the value of any point on a chart.
This is part of a series of tools designed to improve engineers' efficiency.

3.5.1.6 Perform complex equation solving

3.5.1.6.1 Engineers need to be able to solve equations of various complexities, ranging from simple integrals to differential equations and optimization techniques.
This is part of a series of tools designed to improve engineers' efficiency.

3.5.2 Connects with Vendor Database

Identifier	
Description	Must allow Interneer users to search Vendor databases of parts
Rationale	This is critical to achieve a complete, end-to-end solution for engineers.

3.5.3 ASP

Identifier	
Description	Must provide application service provision in the form of CAD, CAM and FEA.
Rationale	The Interneer work environment must allow the ability to run CAD, CAM and FEA in order to provide a complete solution.

3.5.3.1 CAD

3.5.3.1.1 User must be able to store CAD application data on Interneer server account.
This allows users to access and exchange files easily.

3.5.3.1.2 Users can upload/download CAD files in appropriate file format to their accounts so they can be opened with CAD software online/offline.
This is needed for flexibility and ease of exchange between desktop and server.

3.5.3.1.3 User must be able to run CAD application on hourly or quarterly basis.
This provides users with flexibility.

3.5.3.1.4 User must be able to run CAD application in browser, OS and platform independent.
This is important for users who do not have CAD licenses.

3.5.3.2 CAM

3.5.3.2.1 User must be able to store CAM application files on Interneer server account.
This allows users to access and exchange files easily.

3.5.3.2.2 Users can upload/download CAM files in appropriate file format to their accounts so they can be opened with CAM software online/offline.
This is needed for flexibility and ease of exchange between desktop and server.

3.5.3.2.3 User must be able to run CAM application on hourly or quarterly basis.
This provides users with flexibility.

3.5.3.2.4 User must be able to run CAM application in browser, OS and platform independent.
This is important for users who do not have CAM licenses.

3.5.3.3 FEA

3.5.3.3.1 User must be able to store FEA application files on Interneer server account.
This allows users to access and exchange files easily.

3.5.3.3.2 Users can upload/download FEA files in appropriate file format to their accounts so they can be opened with FEA software online/offline.
This is needed for flexibility and ease of exchange between desktop and server.

3.5.3.3.3 User must be able to run FEA application on hourly or quarterly basis.
This provides users with flexibility.

3.5.3.3.4 User must be able to run FEA application in browser, OS and platform independent.
This is important for users who do not have FEA licenses.

3.5.4 Advertisement

Identifier	
Description	Must provide advertisement space.
Rationale	Not only is advertisement a source of revenue, it is also a means to allow our users to continuously be in touch with the latest technology, products and news relating to their industry

3.5.4.1 Ad banners

3.5.4.1.1 Must allow banners on various pages on site.

3.5.4.1.2 Banners must be customized to relate to users expertise and selected criteria.
This is important so that the user only gets targeted and useful ads.

3.5.4.2 News

3.5.4.2.1 Must provide users with the latest news on their respective industry.

3.5.5 Design Guideline Interactive Advisor

Identifier	
Description	Design guideline tool that advises on whether design is valid.
Rationale	Good feature to aide engineers in designing

3.5.5.1 Inspects engineer's work

3.5.5.1.1 Checks to ensure critical errors are not occurring while engineer is designing.
This allows engineers to work with the guidance of the built-in expertise.

3.5.5.2 Optional Feature

3.5.5.2.1 Feature can be disabled by user.

3.5.6 Results Inquiry

Identifier	
Description	Must provide means by which results of an Interneer search be viewed.
Rationale	Provides the means by which the end product of Interneer services may be disseminated.

3.5.6.1 Adjustable results format page

3.5.6.1.1 Engineers can choose the format of the results screen displayed.
User control and flexibility are key elements of the Interneer product.

3.5.6.1.2 Engineers can choose the number of results screen displayed.
User control and flexibility are key elements of the Interneer product.

3.5.6.1.3 Engineers can choose the type of results screen displayed, manufacturing, approved, general, parts

User control and flexibility are key elements of the Interneer product.

3.5.7 Online Journal

Identifier	
Description	Journal saves references of users work on Interneer.
Rationale	This is critical to save engineers time so they do not have to repeat searches.

3.5.7.1 Automatic Storage

3.5.7.1.1 Data is stored automatically on user accounts unless specified otherwise by user and up to the limit of their account storage capacity.

3.5.7.2 Journal Data Encrypted

3.5.7.2.1 Interneer must save data on server in a manner that only the Interneer platform can interpret.
The rational for this is to ensure that users cannot transfer their data to competition making Interneer stickier.

3.5.7.2.2 User can download the journal data for package cost.

3.5.7.3 Journal is Searchable

3.5.7.3.1 User can conduct keyword search through journal.
Ability to search previous user work is very valuable.

3.5.7.3.2 Journal content is linked to expert system.
Expert system needs to be comprehensive and flexible.

3.5.8 Subject to Access Control

Identifier	
Description	All functional categories will be subject to access control
Rationale	Access control needs to be available for all functions

3.6 Performance Requirements

3.6.1 Search Results

Identifier	
Description	Results of keyword search must appear in 5 seconds or less.
Rationale	Users are using Interneer to save time and be more efficient, thus results screens should appear fast.

3.7 Design Constraints

3.7.1 Platform Independent

Identifier	
Description	Interneer must be able to run through any Explorer and Netscape independent of platform.
Rationale	This is important to attract the largest market share.

3.7.2 Auditable Database

Identifier	
Description	Ability to audit activity in database (e.g. track inserts, deletes, adds etc.).
Rationale	This is important for accountability

3.7.3 Windows® Standard User Interface

Identifier	
Description	User interface should conform to "The Windows Interface Guidelines for Software Design" (located on the MSDN Library). Interneer must be immediately familiar to the end user.
Rationale	Following the guidelines laid out by Microsoft will ensure a shorter learning curve for the end user.

In particular, the following features are highly desirable:

1. Hover notes.
2. Right mouse click provides context sensitive options.
3. Must give user the option to navigate through data entry screens without using the mouse, whenever possible, to increase user productivity.

3.8 Operational Constraints

3.8.1 Facilities

3.8.2 Installation

3.8.3 Training

3.8.4 Personnel

3.8.5 Logistics

3.9 Security

Identifier	
Description	Access rights and permissions should be user-based. Access control of all system functionality, audit log, support encrypted data
Rationale	Interneer must project a robust and secure environment.
Criticality	
Source Document	
Verification Method	Analysis
Responsible Person	Romeo Elias
Type	

3.10 Non-Functional Requirements

3.10.1 Producible

3.10.1.1 Implementation

3.10.1.1.1 Implementation should minimize dependencies on specific tools.
(i.e. implementation architecture should be neutral with regard to development tools in order to facilitate future staffing requirements, migrations to new technologies, etc.).

3.10.1.1.2 Implementation should minimize dependencies on arcane developer skills.
(e.g. development should avoid methodologies that rely on arcane skills that may prove to be difficult or prohibitively expensive to acquire when needed).

3.10.2 Testability

Identifier	
Description	System must be defined to a degree that will allow testing that is sufficient to establish conformance with requirements. In addition, the system must be implemented in a fashion that will increase the effectiveness of QA to the highest degree possible.

3.10.2.1 Implementation

3.10.2.1.1 Product should be implemented in such a way as to allow unit testing.

3.10.2.1.2 Modules should be of sufficient granularity as to insure reliability of QA process.
(e.g. the difficulty of defining meaningful test scenarios increases exponentially with the number of functions and/or complexity of a module - inversely decreasing reliability of QA process).

3.10.3 Maintainability

Identifier	
Description	Maintenance of system must be simple, straightforward, and with a minimum of risk.
Rationale	If the system cannot be easily and reliably maintained, the product will not be supportable.

3.10.3.1 Implementation

3.10.3.1.1 System should be modular.
A component model will facilitate isolation and correction of implementation and/or design flaws. In addition, a component model will maximize reuse of development resources.

3.10.3.1.2 Module interfaces must be implemented in such a way as to maximize their longevity.
The amount of development resources required to modify a component interface increases exponentially with the number of components that use those interfaces.

3.10.4 Operability

Identifier	
Description	Must be usable by individuals with minimal or no training.
Rationale	Product must have very low learning curve in order to achieve large market adoption.

3.10.5 Availability

Identifier	
Description	7 x 24 on the Internet

3.10.6 Reliability

Identifier	
Description	System must be reliable
Rationale	Interneer users will want to access their accounts at any time.

3.10.6.1 Implementation

3.10.6.1.1 Product must have thorough and robust exception handling characteristics.
All modules comprising product must be able to detect and properly handle all exceptions, retry recoverable exceptions, etc. without disturbing other processes or shutting down the entire product.

3.10.6.1.2 Product must implement persistent exception handling.
(e.g. error logs).

3.11 Graphical Requirements

3.11.1 Ergonomic Standards

Identifier	
Description	Interneer must follow ergonomic guidelines.
Rationale	This is important since the user will be accessing the site regularly and heavily.

3.11.1.1 Mild Colors

3.11.1.1.1 The selection of colors is critical in ergonomic consideration of the site.
Interneer must be easy to view.

3.11.1.2 Simple Interface

3.11.1.2.1 Non-confusing interface will be ergonomically better.
The simpler the interface, the easier to use and the more intuitive it is.

3.11.2 Matches Company Brand Image

Identifier	
Description	Website image and company brand image must be consistent.
Rationale	This is critical to ensure consistency and branding on all fronts.

4 Appendix

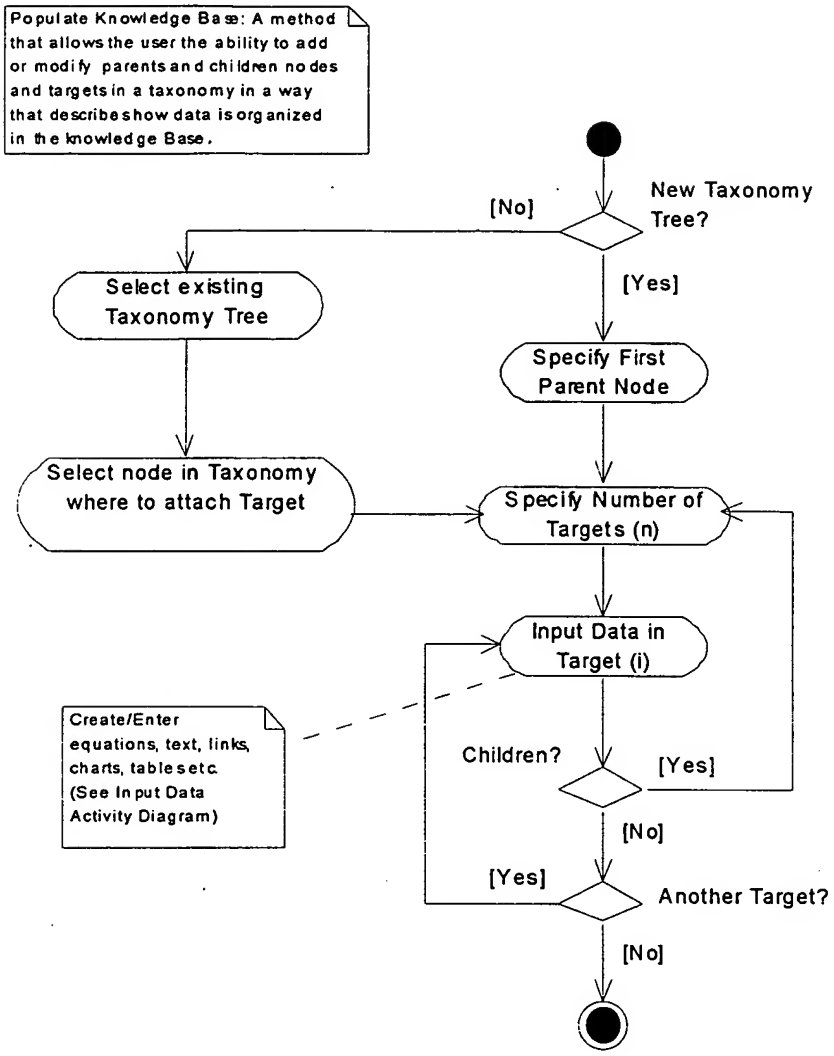
4.1 Activity Diagrams

4.1.1 Embedded Knowledge Management

4.1.1.1 Populate Knowledge Base

A method that allows the user the ability to add or modify parents and children nodes

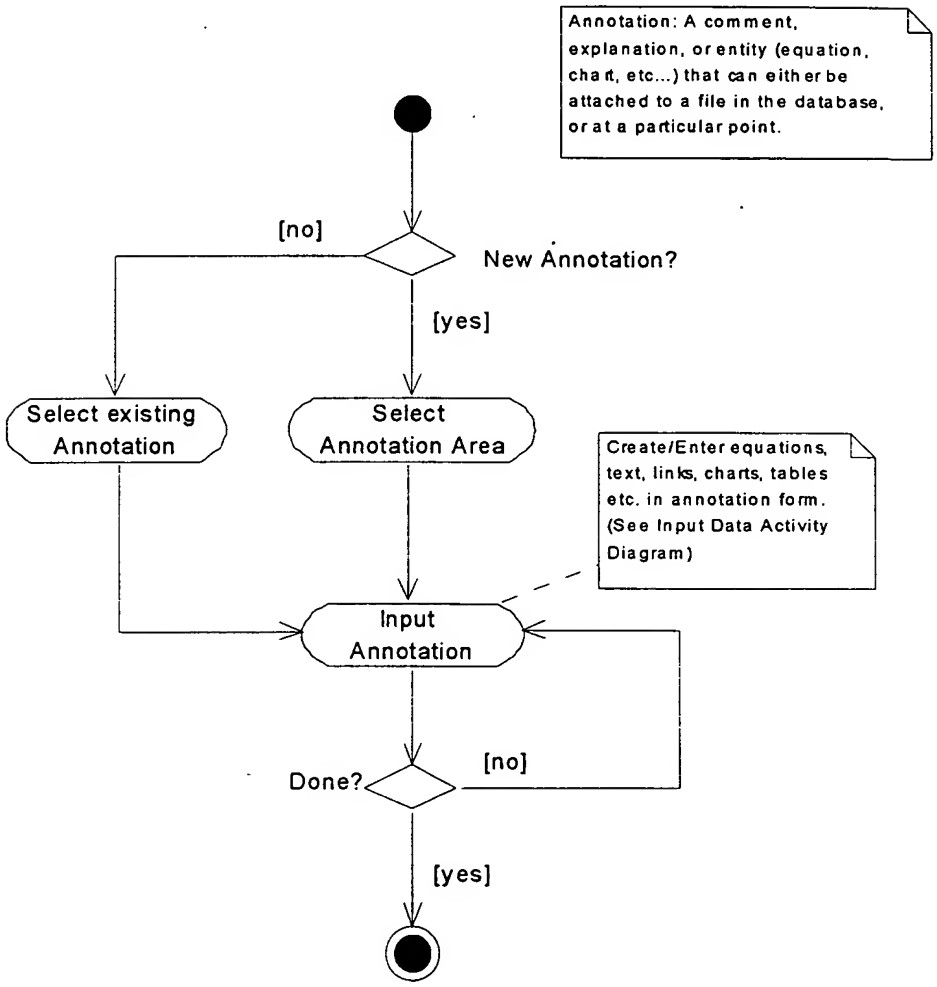
and targets in a taxonomy in a way that describes how data is organized in the knowledge Base.



4.1.2 Embodied Knowledge Management - Annotation

4.1.2.1 Annotate

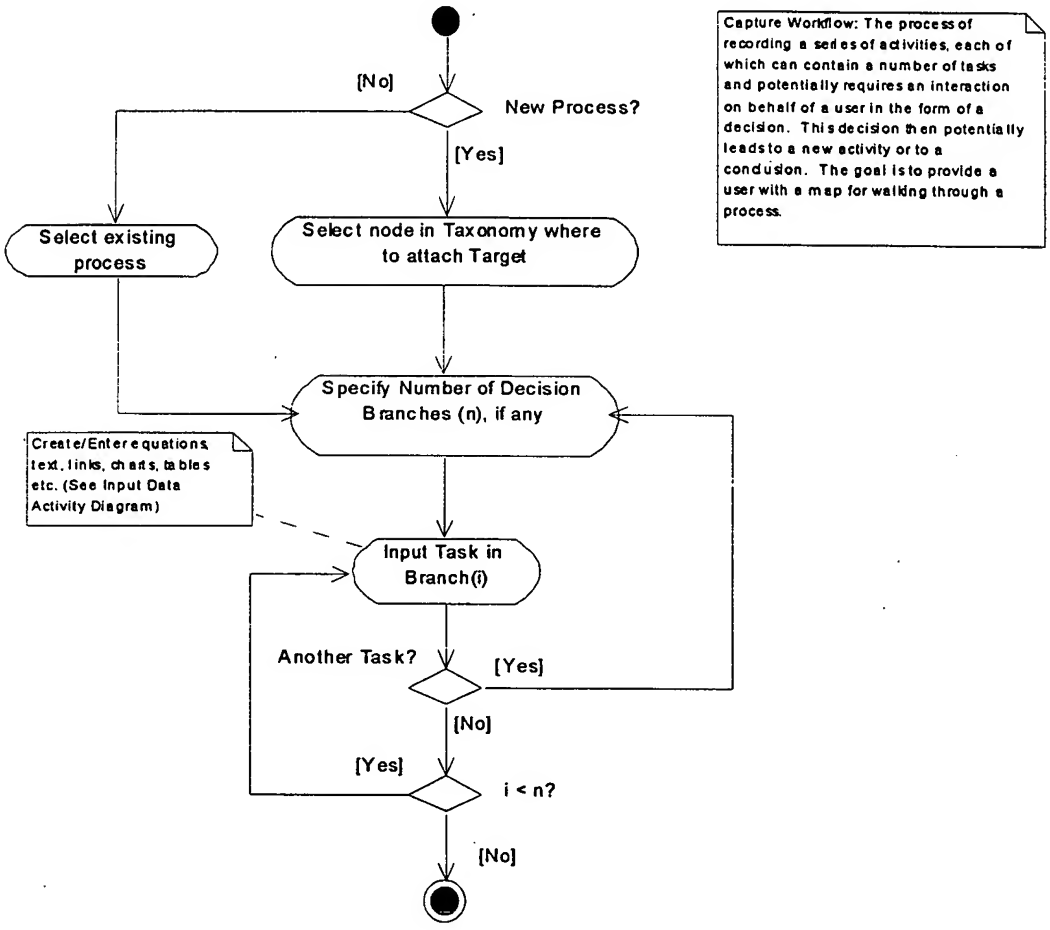
A comment, explanation, or entity (equation, chart, etc.) that can either be attached to a file in the database, or at a particular point.



4.1.3 Workflow Management

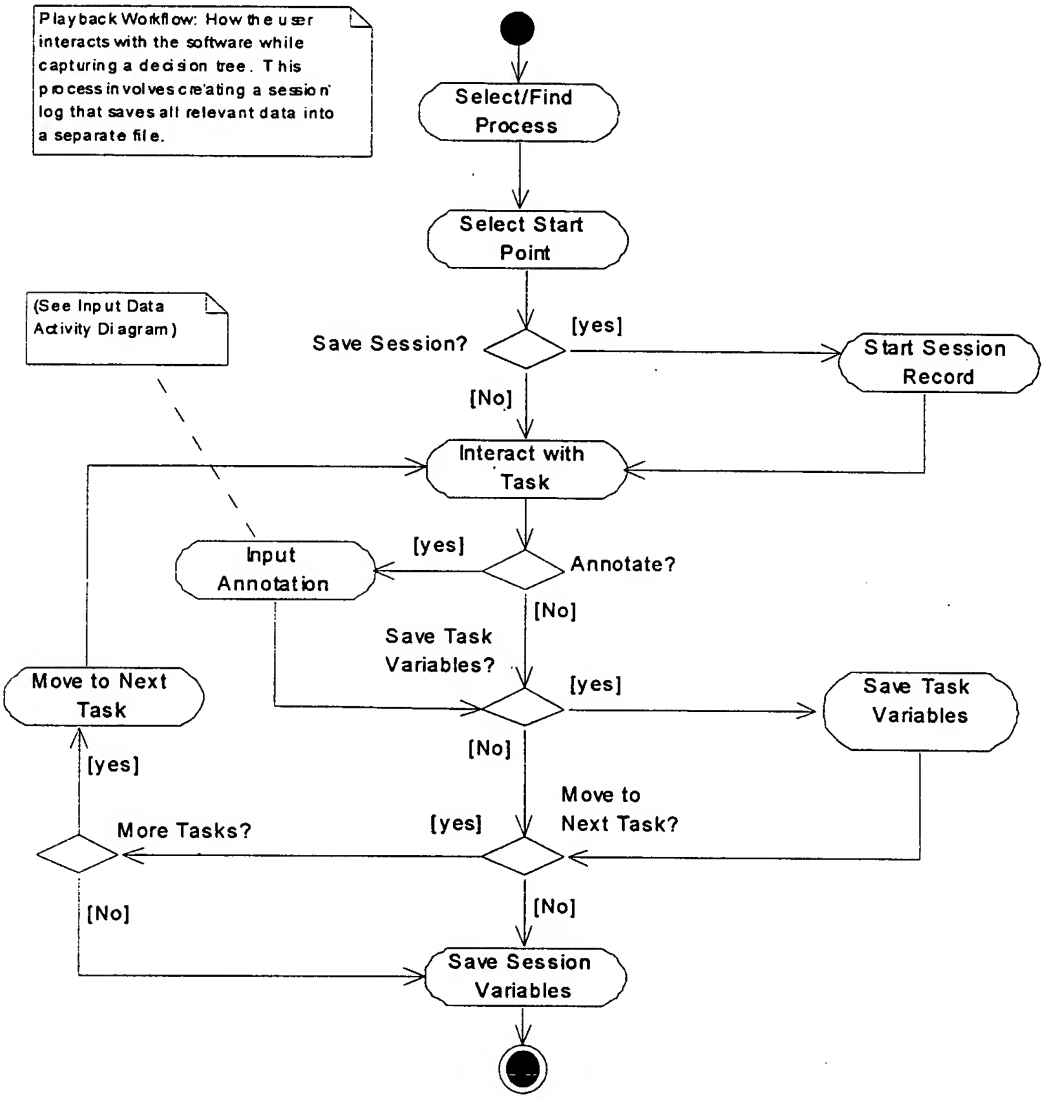
4.1.3.1 Capture

The process of recording a series of activities, each of which can contain a number of tasks and potentially requires an interaction on behalf of a user in the form of a decision. This decision then potentially leads to a new activity or to a conclusion. The goal is to provide a user with a map for walking through a process.



4.1.3.2 Playback

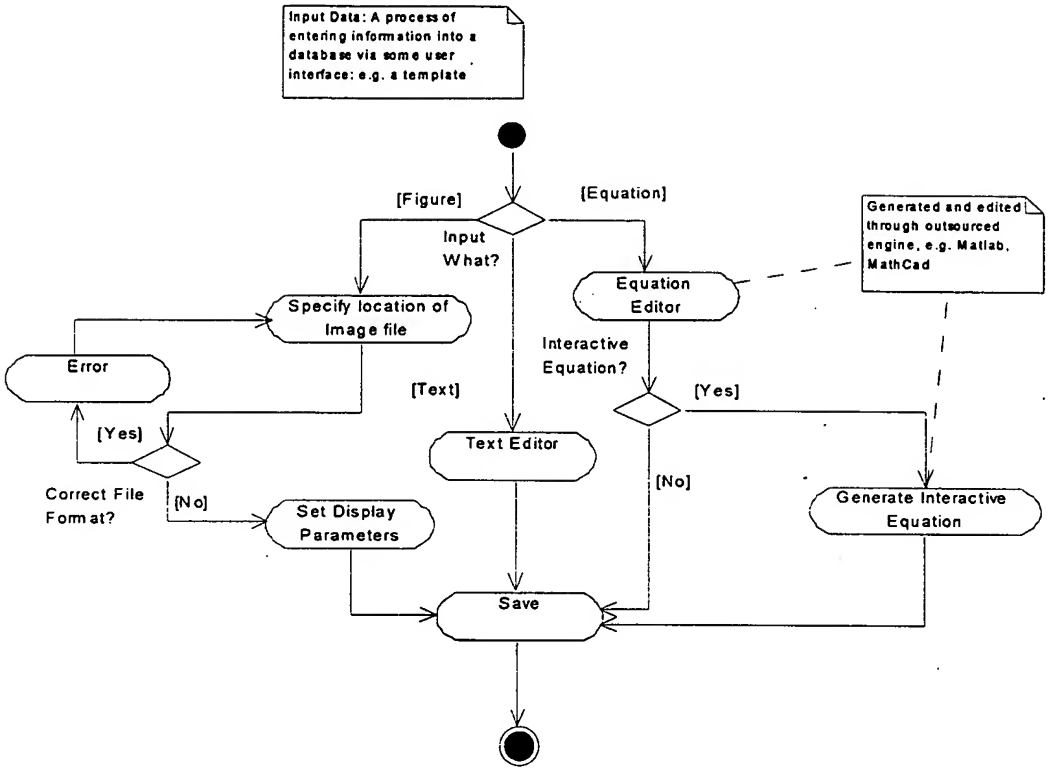
How the user interacts with the software while capturing a decision tree. This process involves creating a session log that saves all relevant data into a separate file.



4.1.4 General Activity Diagrams

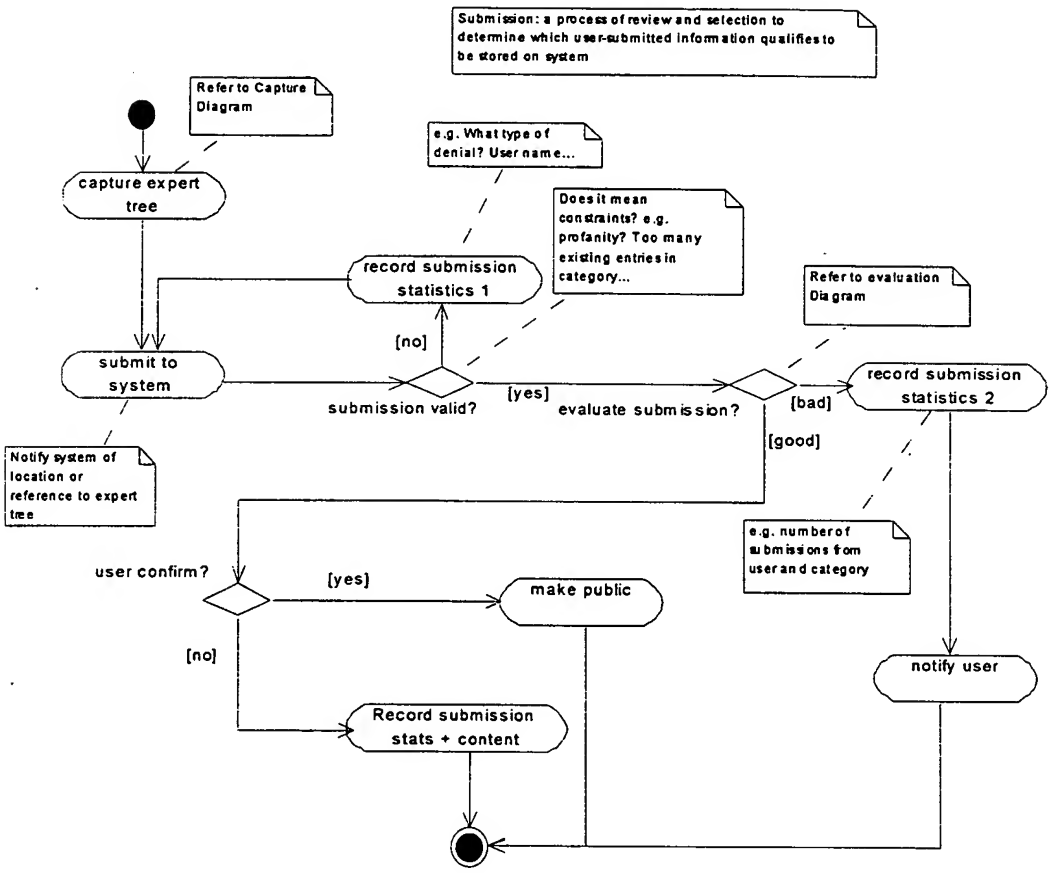
4.1.4.1 Capture

A process of entering information into a database via some user interface: e.g. a template



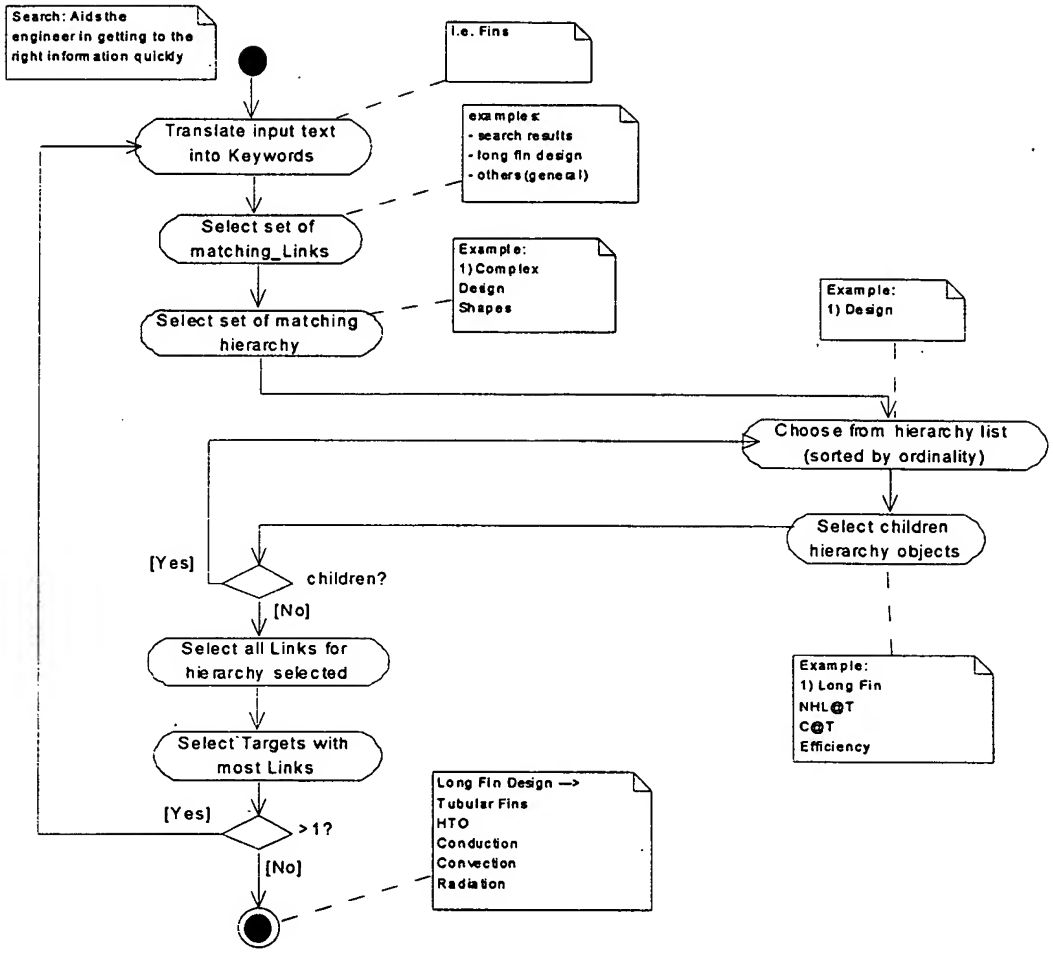
4.1.4.2 Submit

A process of review and selection to determine which user-submitted information qualifies to be stored on system



4.1.4.3 Search

Aids the engineer in getting to the right information quickly



4.2 *Glossary*

Word	Definition	Activity Diagram
Access	A means of entering and making use of the database	Capture Decision Tree
Activity	A specific set of instructions and guidelines provided to a user within a process	Capture Decision Tree
Advise	To provide information to a user for the purpose of guiding them in completing a task	Capture Decision Tree
Annotation	A comment, explanation, or entity (equation, chart, etc.) that can either be attached to a file in the database, or at a particular point	Annotation
Annotation	Refers to a particular point within a file where the user would like to attach an annotation. This point may be any of an equation, chart, text, or figure areas. The annotation area can also refer to an entire	Annotation
Attach	To connect one file to another	Capture Decision Tree
Branch	A specific path within a division of choices a user must make at a given juncture	Capture Decision Tree
Capture Workflow	contain a number of tasks and potentially requires an interaction on behalf of a user in the form of a decision. This decision then potentially leads to a new activity or to a conclusion. The goal is to provide a user with a map for walking through a process.	Capture Decision Tree

Child	A node or target in a Taxonomy that has an associated Parent node	Capture Decision Tree
Conduct	To direct or control the paths taken within a process	Decision Tree Process
Playback Workflow	How the user interacts with the software while capturing a decision tree. This process involves creating a session log that saves all relevant data into a separate file.	Decision Tree Process
Display Parameters	A set of independent variables that define the size, positioning, and format of some entity	Input Data
Edit	To modify or adapt so as to make suitable or acceptable	Input Data
Editor	A program used to edit text or data files	Input Data
Engineering Process	A process consisting of the application of scientific and mathematical principles to practical ends such as the design, manufacture, and operation of efficient and economical structures, machines, processes.	Capture Decision Tree
Equation	A mathematical statement asserting the equality of two expressions	Input Data
Error	A wrong action on behalf of the user, which results in a message informing the user of their mistake and potential courses of action.	Input Data

Existing Process	A file, already created and stored in the database, which contains a series of actions, changes, or functions bringing about a result	Capture Decision Tree
Figure	Some predefined object, which could be a diagram, chart, graph, equation, photo or picture, which is stored and displayed individually	Input Data
Figure Area	Space within a file or on a web page that is occupied by or reserved for a figure	Annotation
Find	To obtain or acquire through a search	Decision Tree Process
Form	A document or file having a preset format, used to enter information to be submitted to modify or create another document or file	Annotation
Generate	To produce something (equation, chart, etc.) by instructing a computer to follow given parameters	Input Data
Generate	To produce (an interactive equation) by instructing a computer to follow given parameters with a skeleton program	Input Data
Hierarchical	Classified according to various criteria into successive levels or layers	Capture Decision Tree
Image File	A file containing a figure	Input Data
Information	Knowledge communicated by users in the form of text, equations, charts, graphs, etc...	Input Data

Input Data	A process of entering information into a database via some user interface: e.g. a template	Input Data
Interact	Ability for users to enter information and for the software to respond based on information entered	Decision Tree Process
Interactive	Implies that an entity can be made to accept input values, process those values (perhaps in the form of a numeric computation), and then create an output so that the display of the entity reflects the new	Input Data
Knowledge Base	The part of an expert system that contains the facts and rules needed to solve problems in engineering	Annotation
Move	To advance to a next step within a particular activity, or from one activity to another within a process	Decision Tree Process
Node	A connecting point within a Taxonomy at which several lines (links) come together -- some lines (links) going to Children, and some coming from Parents	Capture Decision Tree
Parent	A node in a Taxonomy that has a one or more children -- these Children can be nodes or targets	Capture Decision Tree
Process	A series of actions, changes, or functions bringing about a result	Capture Decision Tree
Record	An account, as of information or facts, set down especially in writing as a means of preserving knowledge	Decision Tree Process

Record / Save	To enter and update information within a file, or to create a new file	Decision Tree Process
Respond	To make a reply to a user in the form of an updated web page or file	Input Data
Select	To take as a choice among several	Annotation
Session	The time during which specific activities or processes take place	Decision Tree Process
Specify	To choose explicitly from several options	Taxonomy Tree Input
Start Point	User specified point within a process where they would like to begin a session	Decision Tree Process
Target	An endpoint in a Taxonomy that is either a file or a process. These endpoints are linked to (potentially) multiple parents, but do not have any children associated with them. They can however contain hyperlinks to different areas within the database.	Capture Decision Tree
Task	A function to be performed with some objective in mind. This may entail interacting with an equation to produce a needed numeric value.	Capture Decision Tree
Taxonomy	A division of files into ordered groups or categories -- defines how data is stored and accessed in the database	Capture Decision Tree

Template	A document or file having a preset format, used as a starting point for a particular application so that the format does not have to be recreated each time it is used	Input Data
Text	A body of printed work submitted by a user	Input Data
User	Any person that interacts with the software. Typically this will be an Engineer or Technician	Taxonomy Tree Input
Variable	A quantity capable of assuming any of a set of values. This quantity can be in the form of a symbol in a mathematical expression.	Decision Tree Process

4.3 Use Case Scenarios

4.3.1 Add Annotation

Version	Date	Comments	Approved	Date
00.00.01	11/17/00			

Summary
Actors: Engineer
Manager
Technician
Vendor
Content Worker
Initiating Actor: Engineer, Technician, Vendor, Content Worker (producer of knowledge)
Benefiting Actor: Engineer, Technician, Manager (consumer of knowledge)
Initial Condition: They are 'parked' on a Target
Terminal Condition: Annotated Target

4.3.1.1 Flow of Events for the Add Annotation Use Case

4.3.1.1.1 Preconditions
The User must have initiated a session in order for this Use Case to begin.

4.3.1.2 Main Flow

4.3.1.2.1 This use case begins when the User identifies an entity that they would like to add an annotation to or modify an existing annotation.

4.3.1.2.2 The User then indicates that they would like to add an annotation, and the system prompts the User to select the desired activity: ADD TEXT, ADD EQUATION, ADD FIGURE, ADD TABLE, ADD CHART, or QUIT.
IF the activity selected is ADD TEXT, Add Text Annotation subflow is performed.
IF the activity selected is ADD EQUATION, Add Equation Annotation subflow is performed.
IF the activity selected is ADD FIGURE, Add Figure Annotation subflow is performed.
IF the activity selected is ADD TABLE, Add Table Annotation subflow is performed.
IF the activity selected is ADD CHART, Add Chart Annotation subflow is performed.
IF the activity selected is QUIT, the use case ends.

4.3.1.3 Subflows

4.3.1.3.1 Add Text Annotation

4.3.1.3.2 The system displays the text screen containing fields for textual input and display parameters.

4.3.1.3.3 The user enters their text and parameters.

4.3.1.3.4 The system displays a draft of the proposed annotation.

4.3.1.3.5 The user then selects from a number of activities: ACCEPT, MODIFY, QUIT.
IF the activity selected is ACCEPT, the new annotation is added to the database, and the use case begins again.
IF the activity selected is MODIFY, the user is taken back to the text screen.
IF the activity selected is QUIT, the use case then begins again.

4.3.1.3.6 Add Equation Annotation

4.3.1.3.7 The system displays the equation screen containing modifiable fields for variables and equation parameters.

4.3.1.3.8 The user selects the number of variables contained in the equation.

4.3.1.3.9 The user then has the option to set limits on the values the variables can take.

4.3.1.3.10 The user names each of the variables and enters a brief description of each.

4.3.1.3.11 The user then selects from a number of activities: INTERACTIVE, STATIC.
IF the activity selected is INTERACTIVE, the system creates input fields and an associated numerical equation.
IF the activity selected is STATIC, the system displays a draft of the proposed annotation.

4.3.1.3.12 Add Figure Annotation

4.3.1.3.13 Add Table Annotation

4.3.1.3.14 Add Chart Annotation

4.3.1.4 Alternative Flows

4.3.2 Input Data

Version	Date	Comments	Approved	Date
00.00.01	11/17/00			

Summary

Actors: knowledge worker
knowledge user
administrator

Initiating Actor: knowledge worker
Benefiting Actor: knowledge user
Initial Condition: User is logged in and in the Phenom environment
Terminal Condition: Data file is created

Flow of Events for the *Input Data* Use Case

4.3.2.1 Preconditions

4.3.2.1.1 The user must have chosen a point in the database where they wish to store the particular piece of information.

4.3.2.1.2 The user must be authorized to add information at the point they have chosen.

4.3.2.1.3 If the user is inputting an equation, it is assumed that it is a dynamic equation. Static equations can be entered as text.

4.3.2.2 Main Flow

4.3.2.2.1 This use case begins when the user identifies a point in the database where they would like to add a piece of information.
The user then indicates that they would like to insert data at that point.

4.3.2.2.2 The system verifies that the user has permission to input data at that point and then prompts the user to select the desired activity: ADD TEXT, ADD EQUATION, ADD FIGURE, or QUIT.
IF the activity selected is ADD TEXT, the S2-1: *Add Text* subflow is performed.
IF the activity selected is ADD EQUATION, the S2-2: *Add Equation* subflow is performed.
IF the activity selected is ADD FIGURE, the S2-3: *Add Figure* subflow is performed.
IF the activity selected is QUIT, the use case ends.

4.3.2.3 Subflows

4.3.2.4 Add Text

4.3.2.4.1 The system displays the text screen containing fields for textual input, type, and location parameters.

4.3.2.4.2 The user enters their text, the type of file they are creating (target, node target), and the specific location or locations within the database that the information will lay.

4.3.2.4.3 The user then selects one of two activities: SUBMIT TEXT or CANCEL
IF the activity selected is SUBMIT TEXT, the S2-4: *Submit Text* subflow is performed.
IF the activity selected is CANCEL, the use case then begins again.

4.3.2.5 Add Equation

4.3.2.5.1 The system displays the equation screen containing modifiable fields for variables, equation parameters, and display parameters.

4.3.2.5.2 The user selects the number of variables contained in the equation.

4.3.2.5.3 The user selects the display parameters and type of data file they are creating (target, node target).

4.3.2.5.4 The user has the option to specify limits the values in the variables can take.

4.3.2.5.5 The user names each variable and enters a brief description of each.

4.3.2.5.6 The user names the equation and the system verifies that the name is not already in use.

4.3.2.5.7 The user then selects a desired activity: SUBMIT EQUATION or CANCEL
IF the activity selected is SUBMIT EQUATION, the S2-5: *Submit Equation* subflow is performed.
IF the activity selected is CANCEL, the use case then begins again.

4.3.2.6 Add Figure

4.3.2.6.1 The system displays the figure screen containing fields for figure location and display parameters.

4.3.2.6.2 The user indicates the type of file to be submitted (chart, table, graph).

4.3.2.6.3 The user can then upload a file or browse the database to select a particular file.

4.3.2.6.4 The user sets the display parameters of the figure within the file the system is creating (size, positioning).

4.3.2.6.5 The user names the figure and the system verifies that the name is not already in use.

4.3.2.6.6 The user then selects a desired activity: SUBMIT FIGURE or CANCEL
IF the activity selected is SUBMIT FIGURE, the S2-6: *Submit Figure* subflow is performed.
IF the activity selected is CANCEL, the use case begins again.

4.3.2.7 Submit Text

4.3.2.7.1 The system displays a draft of the proposed text file.
The user then selects from a number of activities: ACCEPT, MODIFY, or CANCEL.
IF the activity selected is ACCEPT, the system updates the database, notifies anyone on the notification list, and the use case begins again.
IF the activity selected is MODIFY, the user is taken back to the text screen as they left it.
IF the activity selected is CANCEL, the use case begins again.

4.3.2.8 Submit Equation

4.3.2.8.1 The system generates a working numerical version of the equation, verifies that the equation is of valid format (E2-1), and then generates the visual display of the equation along with any areas that require user input.

4.3.2.8.2 The system then displays a working draft of the proposed equation file.

4.3.2.8.3 The user interacts with the file by plugging in numbers and verifying that the generated equation is in fact correct.

4.3.2.8.4 The user then selects from a number of activities: ACCEPT, MODIFY, or CANCEL.
IF the activity selected is ACCEPT, the system updates the database, notifies anyone on the notification list, and the use case begins again.
IF the activity selected is MODIFY, the user is taken back to the equation screen as they left it.
IF the activity selected is CANCEL, the use case begins again.

4.3.2.9 Submit Figure

4.3.2.9.1 The system verifies that the file type is recognizable (E2-2).

4.3.2.9.2 The system displays a draft of the proposed figure.

4.3.2.9.3 The user then selects from a number of activities: ACCEPT, MODIFY, or CANCEL.
IF the activity selected is ACCEPT, the system updates the database, notifies anyone on the notification list, and the use case begins again.
IF the activity selected is MODIFY, the user is taken back to the figure screen as they left it.
IF the activity selected is CANCEL, the use case begins again.

4.3.2.10 Alternative Flows

4.3.2.10.1 An invalid equation is entered. The system prompts the user with an error message pointing them to the problem area and also displays the equation screen so that the user can fix the problem.

4.3.2.10.2 An invalid figure type is submitted. The system prompts the user with an error message indicating that the file type is unknown and also displays the figure screen

so that the user can either enter a new figure or cancel the transaction. The system should also send a message to the administrator indicating a new type of file.

4.3.3 Populate Knowledge Base

Version	Date	Comments	Approved	Date
00.00.01	11/17/00	First Draft Release for review		

Summary
Actors: knowledge worker
knowledge user
Initiating Actor: knowledge worker
Benefiting Actor: knowledge user
Initial Condition:
Terminal Condition:

Flow of Events for the *Populate Knowledge Base* Use Case

4.3.3.1 Preconditions

4.3.3.1.1 The User must have initiated a session in order for this Use Case to begin.

4.3.3.2 Main Flow

4.3.3.3 Subflows

Alternative Flows

4.3.4 Submit and Review

Version	Date	Comments	Approved	Date
00.00.01	11/17/00			

Summary
Actors:
Initiating Actor:
Benefiting Actor:
Initial Condition:
Terminal Condition:

Flow of Events for the *Submit and Review* Use Case

4.3.4.1 Preconditions

4.3.4.1.1 The User must have initiated a session in order for this Use Case to begin.

4.3.4.2 Main Flow

4.3.4.3 Subflows

4.3.4.4 Alternative Flows

4.3.5 Expert Guidance

Version	Date	Comments	Approved	Date
00.00.01	11/17/00			

Summary
Actors:
Initiating Actor:
Benefiting Actor:
Initial Condition:
Terminal Condition:

Flow of Events for the *Expert Guidance* Use Case

4.3.5.1 Preconditions

4.3.5.1.1 The User must have initiated a session in order for this Use Case to begin.

4.3.5.2 Main Flow

4.3.5.3 Subflows

4.3.5.4 Alternative Flows

4.3.6 Approve or Reject Submission

Version	Date	Comments	Approved	Date
00.00.01	11/17/00			

Summary
Actors:
Initiating Actor:
Benefiting Actor:
Initial Condition:
Terminal Condition:

Flow of Events for the *Add Annotation* Use Case

4.3.6.1 Preconditions

4.3.6.1.1 The User must have initiated a session in order for this Use Case to begin.

4.3.6.2 Main Flow

4.3.6.3 Subflows

4.3.6.4 Alternative Flows

4.3.7 Define Workflow

Version	Date	Comments	Approved	Date
00.00.01	11/17/00			

Summary

Actors: knowledge worker
knowledge user

Initiating Actor: knowledge worker
Benefiting Actor: knowledge user
Initial Condition: User is logged in and is in the Phenom environment
Terminal Condition: A workflow is created

Flow of Events for the *Define Workflow* Use Case

4.3.7.1 Preconditions

4.3.7.1.1 The User must have initiated a session in order for this Use Case to begin.

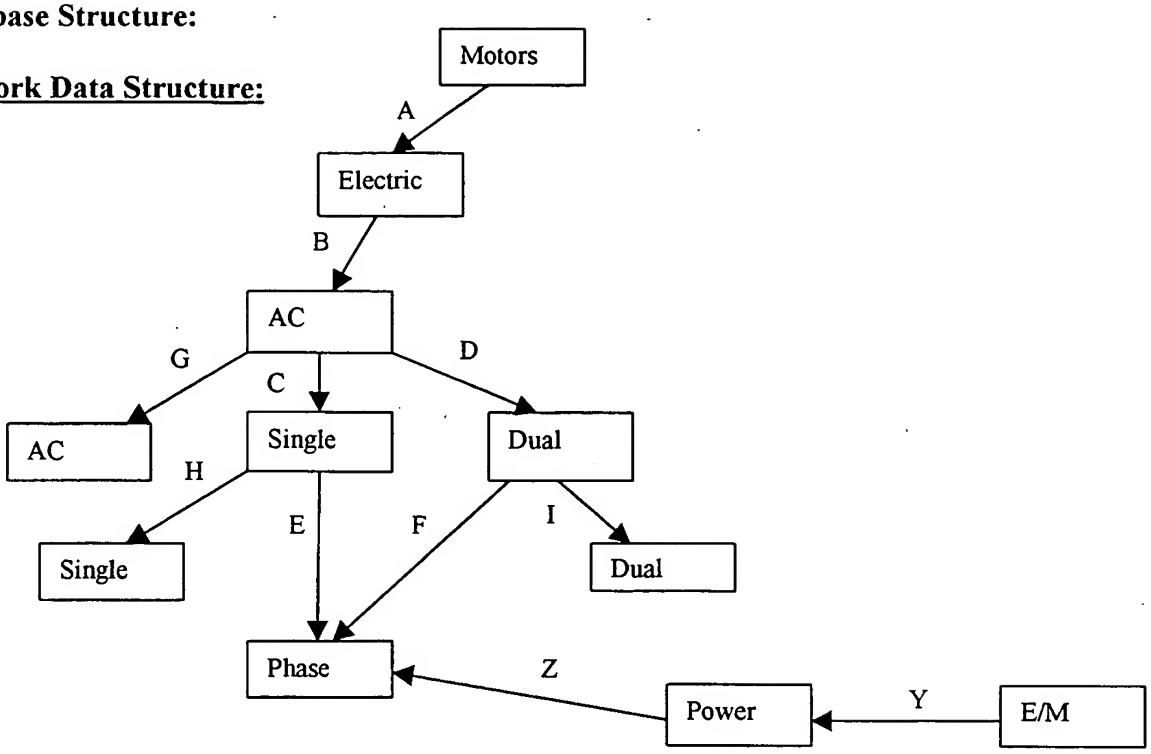
4.3.7.2 Main Flow

4.3.7.3 Subflows

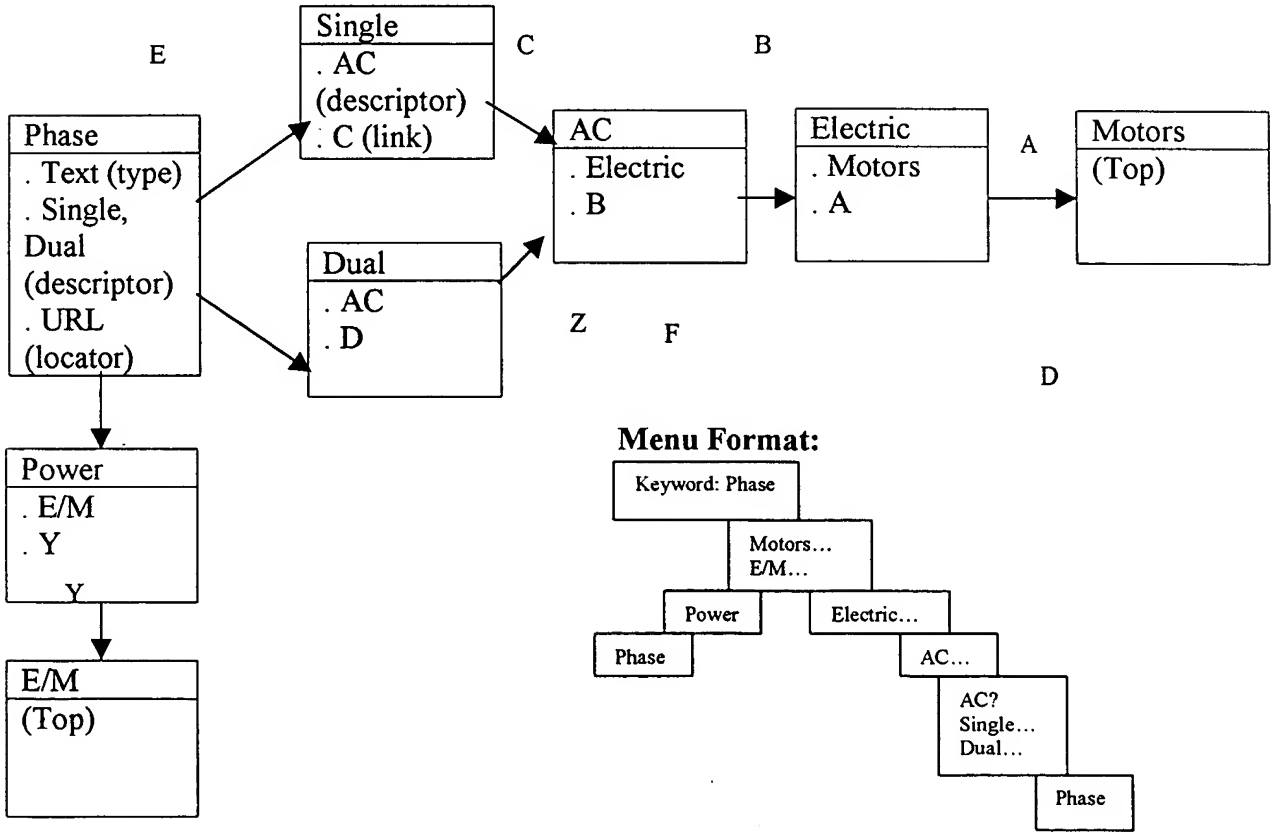
4.3.7.4 Alternative Flows

Database Structure:

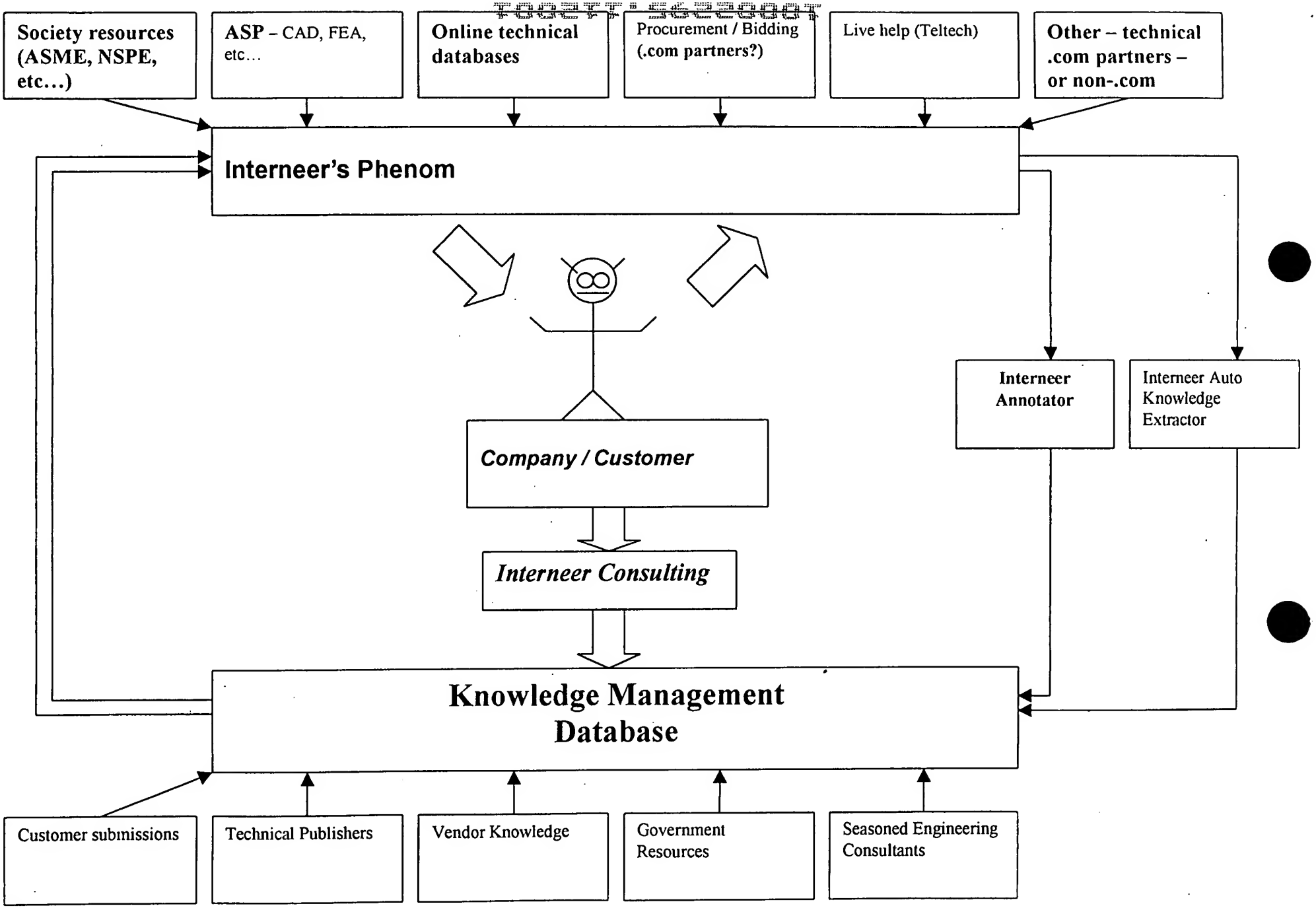
Network Data Structure:



Target, Node and Link Class Relationships:



Menu Format:


Society resources (ASME, NSPE, etc...)
ASP – CAD, FEA, etc...
Online technical databases
Procurement / Bidding (.com partners?)
Live help (Teltech)
Other – technical .com partners – or non-.com
Interneer's Phenom
Company / Customer
Interneer Consulting
Interneer Annotator
Interneer Auto Knowledge Extractor
Knowledge Management Database
Customer submissions
Technical Publishers
Vendor Knowledge
Government Resources
Seasoned Engineering Consultants

The following section provides a brief description of each of the Figures, which portray one preferred embodiment of a network-accessible embodiment of the invention.

Figure 1

Interneer provides a secure account for each user. The user navigates on the Internet (or extranet/intranet, depending on user preference) through a browser. Then they enter their unique username and password and press login. Interneer then checks their username, matches it to their password, and ensures the user isn't already logged into the site.

The user can also be identified with a specific community (e.g. their company). This login page can be customized for different user communities both functionally and graphically (brand etc.). If the user is identified with multiple communities, they can be prompted with a request for choosing their desired destination. The user can also customize their settings to choose the next page after login. They can choose from a number of pages including a search page, a community page, a portal page, or others.

Figures 2 and 3

These figures show the Search and Browse page. In this page, the user has access to all the tools and functionalities they specify when setting up their customized account (default settings are also available). They can review their online journal (activity log) of their previous designs, previous interactions with the software, and purchases; they can choose to view a list of online software that they can deploy online; they can go to the research area where they can browse the latest news and research on engineering, technology, and any other topic they specify; they can access their account information which details their recent purchases and membership information; and finally they can choose to personalize the availability, layout, and operation of specific functions and searches. Additionally, many features will be made available to users in packages. Advertisements can also be placed on the page and can be dynamically generated based on the user's past interaction with the software, their user community, and the request of the advertisers.

Other key areas that can be accessed from this screen are the project management, collaboration and access control tools. Interneer allows users to create folders and store them as well as provide controlled access to them. Users can track project progress, goals and milestones achieved. If they choose to, they can view other users' work and also make theirs available. They can view the work real-time or by simply accessing others folders or emailing the work pages.

The search and browse works in the following manner:

a) Keywords are entered into one of the search boxes. Each of the search boxes is primarily associated with a different database of information that is being searched, however all databases are cross-linked in a neural network of knowledge bundles. If the user wants to

search the same primary keywords in multiple databases, all they need to do is enter them in one and check the other boxes those same keywords need to be searched in. If the user wants to search different primary keywords in different databases, all they need to do is enter different keywords in the different search boxes. This way, for example, a user can search for "motors" under the 'manufacturing' box and "motor design" under the 'problem' box. The result of these searches would be information on motor manufacturers as well as guidelines on motor design.

b) The user then clicks on the downward-pointing triangle to the right of the box they entered keywords in. This triggers the software to conduct the search based on those keywords and return a list of categories that relate to these keywords in a drop down list. So in the specific case of "Heat Sink" being entered in the 'part description' box, a list of categories is returned for the user to browse through. If the user then clicks on a specific category in the list, and the category has sub-categories associated with it, another drop down list is presented – all the while the original list remains open and in its original position. These additional sub-category lists continue to be displayed with each click by the user until there are no more sub-categories. Every category, however, does have an associated end point. Once a user clicks on a sub-category that has no more sub-categories under it, a record of the categories and sub-categories is listed on the page above the box to provide feedback to the user about what selections have been made. Now, if a user is browsing down the categories and sub-categories and realizes they have taken a wrong path, they can then browse to different areas or back up to a point where they feel they want to see all the sub-categories there, not necessarily relating to the keyword initially entered. This allows the user to see a larger picture of how the results are determined and provides more freedom and flexibility for them to change their minds.
c) Step b) is repeated in every box as desired by user.
d) The user presses the GO button, and is then taken to the result page for the specified query. If more than one result exists, the user is shown one expanded result first and a list of links to others. The expanded result is the software's 'best guess' at what the user is looking for and is based on where the information lies in the taxonomy, how often it has been accessed previously (by this or other users), and other weighting factors. Also, the results of the different databases searched will be displayed based on the customization the user implements in the personalization section.

Figure 4

This is an embodiment of a sample results page explaining how to conduct an engineering process (it can also be a process in another field depending on the application of the software). On the left side of the screen we see a number of icons, which will be explained as we describe the different pages. The icons to note here are the 'Be an Expert' icon which allows the user to submit a form which describes their aptitude and experience regarding a certain engineering topic so that Interneer staff members can evaluate them as a potential reference for the specific topic displayed on the page; the 'Help' icon which takes users to an online help on how to use the site and also connects you with experts in the specific area displayed on the page; the 'Software' icon which provides access to the latest engineering software that is accessible

directly on Interneer. This software can be CAD, CAM, CAE, FEA or other software that is useful to the user – the data from the software can be stored in the user's personal accounts; the 'Research' icon which takes users to the latest information on engineering and technology research and news; the 'Personalize' icon which takes users to the personalization screen; the 'Account Info' icon to show users their account status, details and pending purchases or payments; and the 'Journal' icon which takes users to their online activity log.

At the top of the screen, we note that there are two tabs; the 'Search Results' and 'Problem Description' tabs. These tabs are shown minimized, and when maximized, they provide a list of additional results and cross-references to this topic based on your search. The latter describes in detail the problem that is being solved and the background information that is needed to understand it. Page 5 shows these 2 tabs expanded. The reason for the location is to ensure that engineers are not bombarded by information and text as they are when reviewing a handbook. The information is non-intrusively presented providing the user the flexibility to read or not.

Below that, we see a diagram of nodes. The nodes represent the different steps a user would follow in order to complete the process or guideline. So, at the first step, all possible choices lead to three different steps. Depending on which step a user picks, they will be directed to the appropriate one and then to the one after based on the diagram. So in the case on page 4, if the user selects 'computer chips', they will be taken to the 'Computer Chips Fin #' step. If they select 'Motors' or 'Pipes', they will be taken to the 'Motors/Pipes overall' step. And if they select 'Micro Technologies' or 'All other applications', they will be taken to the 'Micros/Other Description' step. Now, the first 2 choices lead to additional steps, but the third stops there. The user can view by looking at this diagram the whole layout of the guideline.

In the middle of the screen are presented the Process Title, Step Title and the descriptions as well as choices the user needs to make in order to move to the next step. Once a choice is made, the user can then hit 'Step 2' to move on to the next appropriate step, based on what the diagram shows.

These pages are highly customizable both functionally and by layout. The idea is to provide the maximum level of convenience and access to users. Each of their interactions is recorded for later perusal. By making all of these resources available in one place, the users are able to save a great deal of time in their work, they are less prone to mistakes, and they are afforded greater freedom in making creative and innovative decisions.

Figures 5 and 12

This figure shows a web page that demonstrates Step 2 of the 'How to Design a Heat Sink' process. In this case we see in the main section of the page an equation with variables that are defined underneath along with field boxes, a figure and an assumptions paragraph.

The equation is interactive in the sense that users can enter data into the fields to the right of the variable descriptions, leave any of the fields blank, hit the 'Solve' icon and The software will

then figure out which variable to solve for (i.e. the blank one) and display a result. A drop down is also seen on the screen for selection of a material, so that when the user selects a material, the property values (e.g. modulus, density etc.) are automatically entered into the appropriate field in the equation variable list – in this case, for "h" and "k". Also, there are drop downs for each variable for possible units to use. These drop downs allow users to specify any applicable unit for any applicable variable and to select an output unit different than the others. So, for example, a user can specify Watts for "Q", and Degrees Fahrenheit for "T0", and inches for perimeter, and request the cross-sectional area to be in millimeters squared.

The figure in the middle of the screen is also interactive. The user can type directly into boxes on the image the values of the equation variables where applicable. Also, the 3D shape of the figure will change dynamically based on the values entered for the variables when applicable (e.g. for perimeter, area etc.). When done iterating the values in the equation and solving the equations, the user can simply click on the image and choose to download it with the appropriate shape and file format (a certain CAD file format for example) to their computers.

The 'Assumptions' section on the screen describes constraints and guidelines on when the equation is usable and other issues the user should look out for (implementation/application issues, etc.). The assumptions screen is also linked to the values entered for the variables and checks to see if a value does not fit the constraint. So for example, there may be an assumption that states that the length cannot be larger than 100cm. So if the user enters 99cm, the software will prompt them and warn them about the violation. The assumptions can tie multiple variables together; such as saying the length must be twice the width. An additional feature determines, on a more macro level, if any constraints are being violated in the interaction of the particular equation with other designs in a project or a collaborative effort. In other words, on page 5 is shown one particular design application, however this design may in fact be one piece of a larger design (in this case perhaps the design of a desktop computer for example).

In addition to solving the equations dynamically online, the user can also choose to conduct design tradeoff analyses by leaving two or three fields empty thus prompting the software to plot the selected variables in 2D or 3D against each other in order to optimize their solutions to the equation and in the design. When the user leaves 2 or 3 variables blank, the software will then prompt them to specify which variable for which axes and what the range to plot is. Then a plot is generated (for example in the place of the figure, depending on specified customization layout) and shown on the same screen as shown on Page 12.

The 'Tables' icon allows the user to look up constants, material properties, empirical data, etc. This data can be presented in the form of tables or charts and the software will allow the user to adjust the axes definitions if it's a chart so that it is reproduced based on the new definition. In other words, the tables and charts can be customized and dynamically generated. With the tables, Interneer allows the user to specify a value in between two adjacent table values and the software provides an interpolated result.

Figures 6 and 7

These figures portray how a user can capture their knowledge. Interneer provides multiple ways of capturing knowledge:

a) The user's work is by default being captured in a history feature, which holds a link to all the work and data they accessed, in all their interactions with the software, as well as entered into the pages for a certain period of time. The history may or may not ultimately expire based on user settings or default software settings. This feature essentially stores a detailed journal of the user's actions and interactions and is one form of knowledge capture. The software can also detect and store users' actions when they leave the Interneer site and interact with other software applications they find useful in their daily activities.
b) The user can also click the 'Save' icon, which creates a bookmark to that specific page along with the data the user entered into that page (e.g. values of equations etc.). By clicking on 'Save', the user is specifying that this specific page is more valuable to them than the others in the history. This bookmarked page may also be found in the history and is displayed to the user in their journal area and represents more valuable knowledge that the user chose to capture.
c) The user can also click the 'Annotate' icon, which, as shown in page 6, shows a list of annotations that were previously created by them, other users, or even Interneer. The list of annotations may always be shown to the user without having the user click the icon. The user can also choose to create, edit, search or delete existing annotations by interfacing with the annotation tool as can be seen on page 7. The annotations also track who entered the annotation, ensuring that no user can assume another's identity and annotations are subject to review and access control. So, once an annotation is submitted, it is automatically approved if it is only for personal use, and is subject to review if it will be accessible to other users in an organization or to the Interneer community of users as a whole.

Figure 8.

Once the user has completed designing on Interneer and has specified the values for the different variables that define the part they are seeking, they can then click on the 'Suppliers' icon which conducts a search into vendor databases of parts and presents a list of suppliers who carry the part in stock. Information on lead-time, availability, cost, and properties of the specific part is presented. The information presented is based on the actual values inputted and the decisions made while the user interacts with the software in a given design process.

The vendors are divided into "approved" and "General", where the former represents suppliers that have been designated as approved by the user or their organization to use for whatever reasons, and the latter represents suppliers that have not been screened by the user or organization. "Approved" can also imply many other things such as that the vendor has been used by Interneer customers and has received favorable reviews. The user can specify the definition in their customized settings.

"Going Orders" are also listed to show who else in the organization is ordering from the suppliers so that the user can choose to consolidate orders and save time and money.

The search also provides a list of suppliers that have parts that are similar to the one predefined by the user but slightly different, so that the user can choose to modify their design if needed to improve cost or lead-time on the part. This feature provides the user with a great deal of information to be used in their design tradeoff analyses. In product design for example, many times engineers are unaware that by making adjustments to their specifications, but still maintaining their design constraints, they can save an enormous amount of money. By clicking on the supplier name, the user is then taken to a page that shows further information on the vendor.

It is also important to note that the user can share the information in this page with colleagues, procurement agents, customers, managers etc. They can do this by collaborating online, viewing the same page in real-time or by emailing the page to the other parties. In this page, the user can also add annotations or view others'.

Figures 9 and 10

These figures demonstrate another example where the user searches under the 'Problem' database for Bearing Life designs. Figure 10 shows another interactive equation as part of a process that the engineer can use with assumptions.

Figure 11

If at any time the user clicks on the 'Capture' icon, they are then taken to the capture template. This is another way for the user to capture knowledge. Specifically, they can capture any process they find useful in their daily work, or that they feel another user (either in their community or the Interneer community at large) would find useful. These processes can range from designing a handheld electronic device to specifying an accounting best practice to a decision tree for cooking pasta. The only limitations are the users' imaginations. Any information intensive industry in particular will find this feature especially useful. The user enters the process title, the step title, description text, inserts a figure if necessary, inserts an equation if applicable, and then specifies conditions as needed. For example, to create a process such as the one starting on page 4, the user does the following:

a) They specify a Process Title as shown.
b) Then they specify a step title.
c) Description of the problem is entered as needed in the Description box.
d) The user can click on 'Browse' to pick an image from their directory and upload it to Interneer.
e) The user can enter an equation in text format into the equation box, and then click 'Insert Equation'. This will then provide the user a list of all the variables in the equations in a form, allow them to specify descriptions for each, and what type of unit family they fall under (e.g. length, energy, force etc.). If there are constraints on the values for each of

the variables or for how two of them interrelate, then the user can specify that. Once the equation variables have been defined, assigned units and constrained as necessary, the user can then save it.

f) The user then saves the whole page by clicking on the 'SAVE' button inside the form. By doing that the first step of the process is dynamically created and stored. Now the user can specify whether there are decisions or choices to be made. So, here the user can click on 'Add' to add a condition. This then opens up a new blank template screen, which can be populated similarly with equations and text etc. The condition will also capture the logic or decision that will define when the user will go to one step or the other. The conditions could be tied to values in the equations, to choices the users make, to shapes of the image etc. This process can be repeated vertically down one condition to build one branch of a decision tree and horizontally to allow creation of multiple branches. The user can use the commands on the template to navigate up and down the decision branches and from one to another. The user will also be able to decide what the layout of the screen will look like when this process is played back.

g) When the user has completed the capture process, they can then save it under the appropriate database. They can come back to it later and delete, edit or create more.

h) Once it is stored in the database, now a user who is searching can find it and navigate through the new process.

Once a process is captured, the user then saves it in their own personal account, or submits it to their community or to Interneer for review and submission to the entire Interneer user community. If it is reviewed and accepted, then it is deployed to other users in the community or to the Interneer community as a whole.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LOGIN NAME:
PASSWORD:
Login
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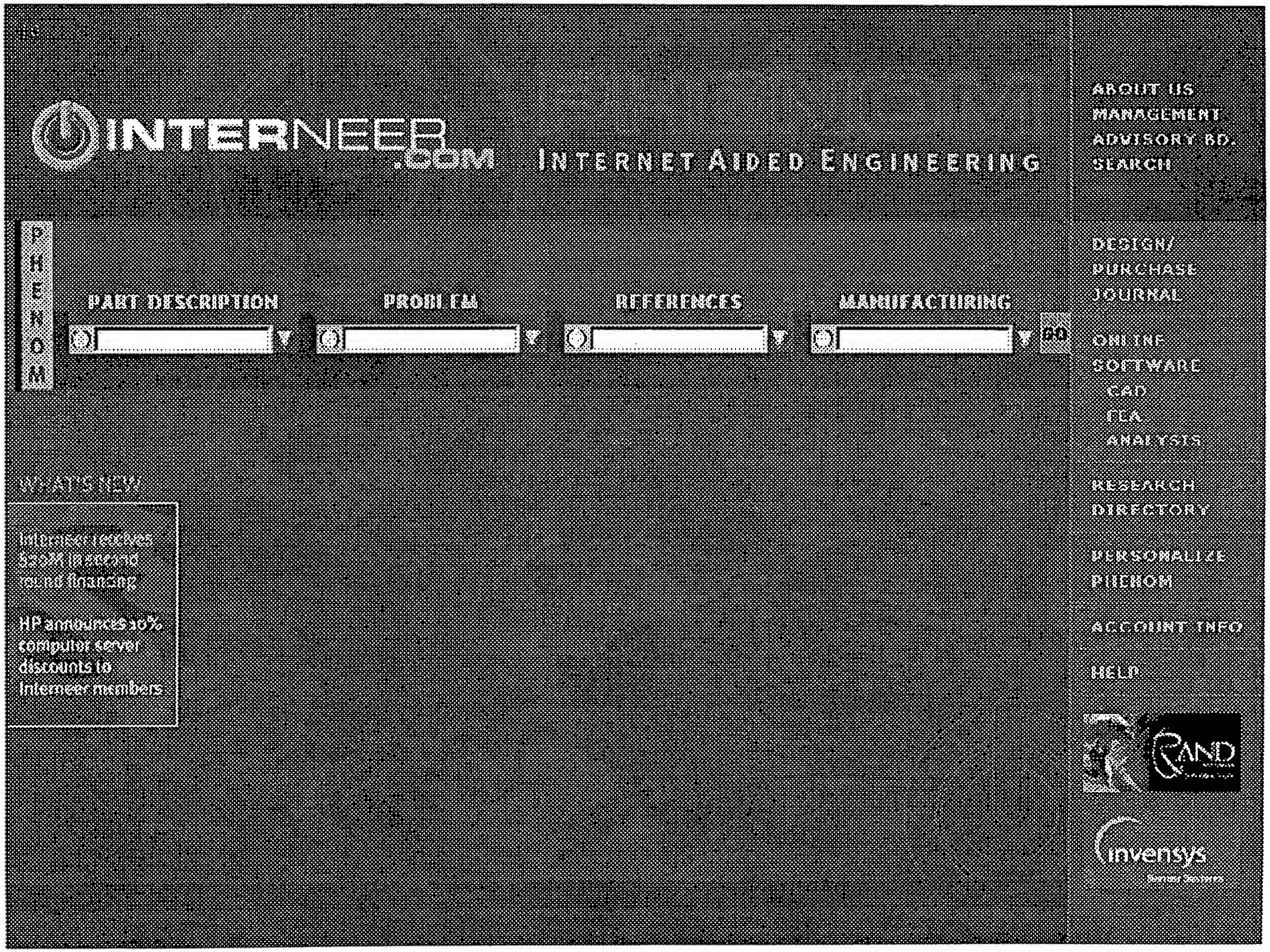
Figure 1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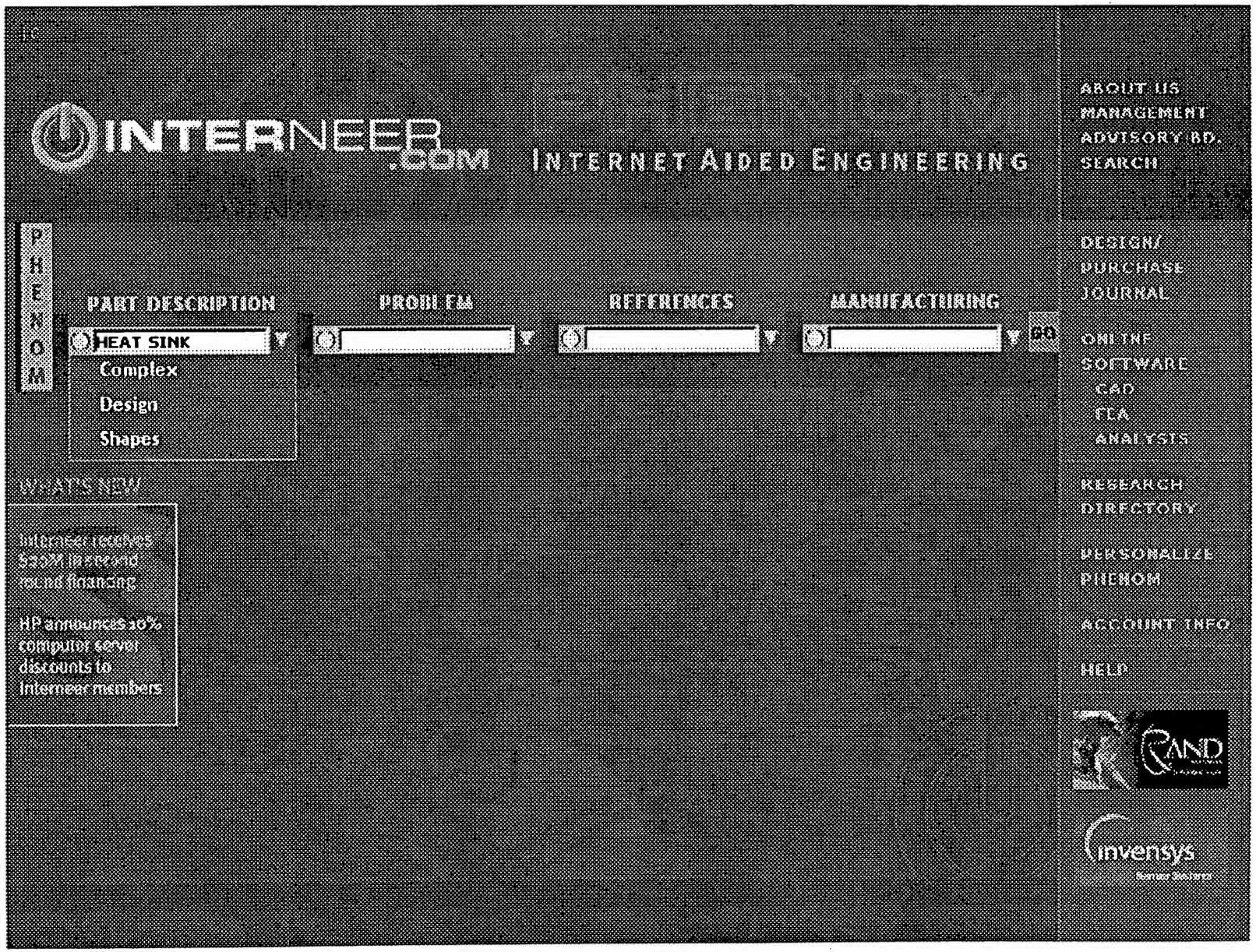
DESIGN/
PURCHASE
JOURNAL
ONLINE
SOFTWARE
CAD
FEA
ANALYSIS
RESEARCH
DIRECTORY
PERSONALIZE
PHENOM
ACCOUNT INFO
HELP
WHAT'S NEW
computer server
discounts to
Interneer members
RAND
invensys

Figure 2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PERSONALIZE
PINBOM
ACCOUNT INFO
HELP
PINBOM
PART DESCRIPTION
PROBLEM
REFERENCES
MANUFACTURING
GO
HEAT SINK
Complex
Design
Shapes
WHAT'S NEW
Interneer receives $30M in second round financing
HP announces 30% computer server discounts to Interneer members
RAND
invensys

Figure 3

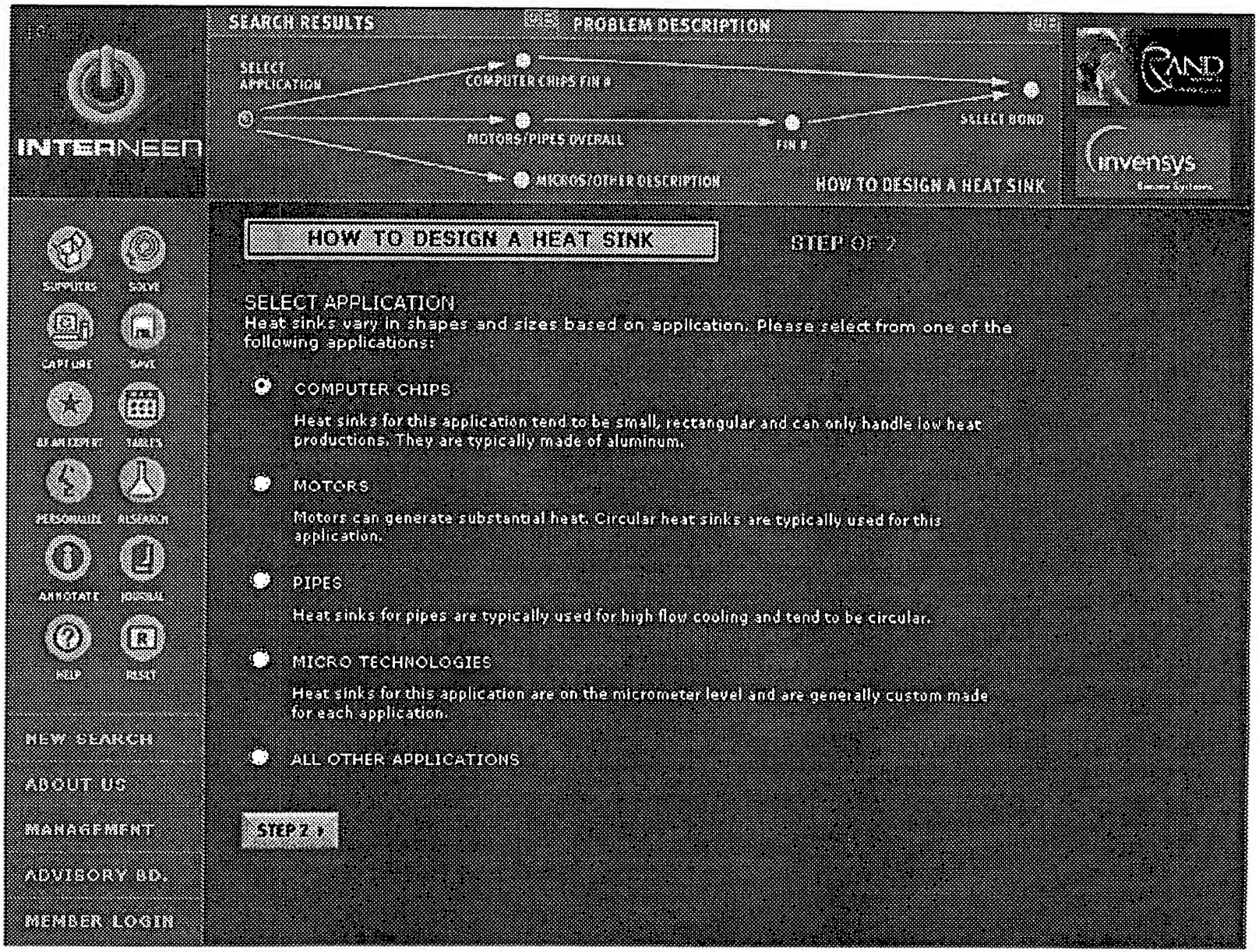

SEARCH RESULTS
PROBLEM DESCRIPTION
SELECT APPLICATION
COMPUTER CHIPS FIN P
MOTORS/PIPES OVERALL
FIN P
SELECT BOND
MICROS/OTHER DESCRIPTION
HOW TO DESIGN A HEAT SINK
INTERNEER
Invensys
HOW TO DESIGN A HEAT SINK
STEP OF 2
SELECT APPLICATION
Heat sinks vary in shapes and sizes based on application. Please select from one of the following applications:
COMPUTER CHIPS
Heat sinks for this application tend to be small, rectangular and can only handle low heat productions. They are typically made of aluminum.
MOTORS
Motors can generate substantial heat. Circular heat sinks are typically used for this application.
PIPES
Heat sinks for pipes are typically used for high flow cooling and tend to be circular.
MICRO TECHNOLOGIES
Heat sinks for this application are on the micrometer level and are generally custom made for each application.
ALL OTHER APPLICATIONS
STEP 2 >
NEW SEARCH
ABOUT US
MANAGEMENT
ADVISORY BD.
MEMBER LOGIN

Figure 4

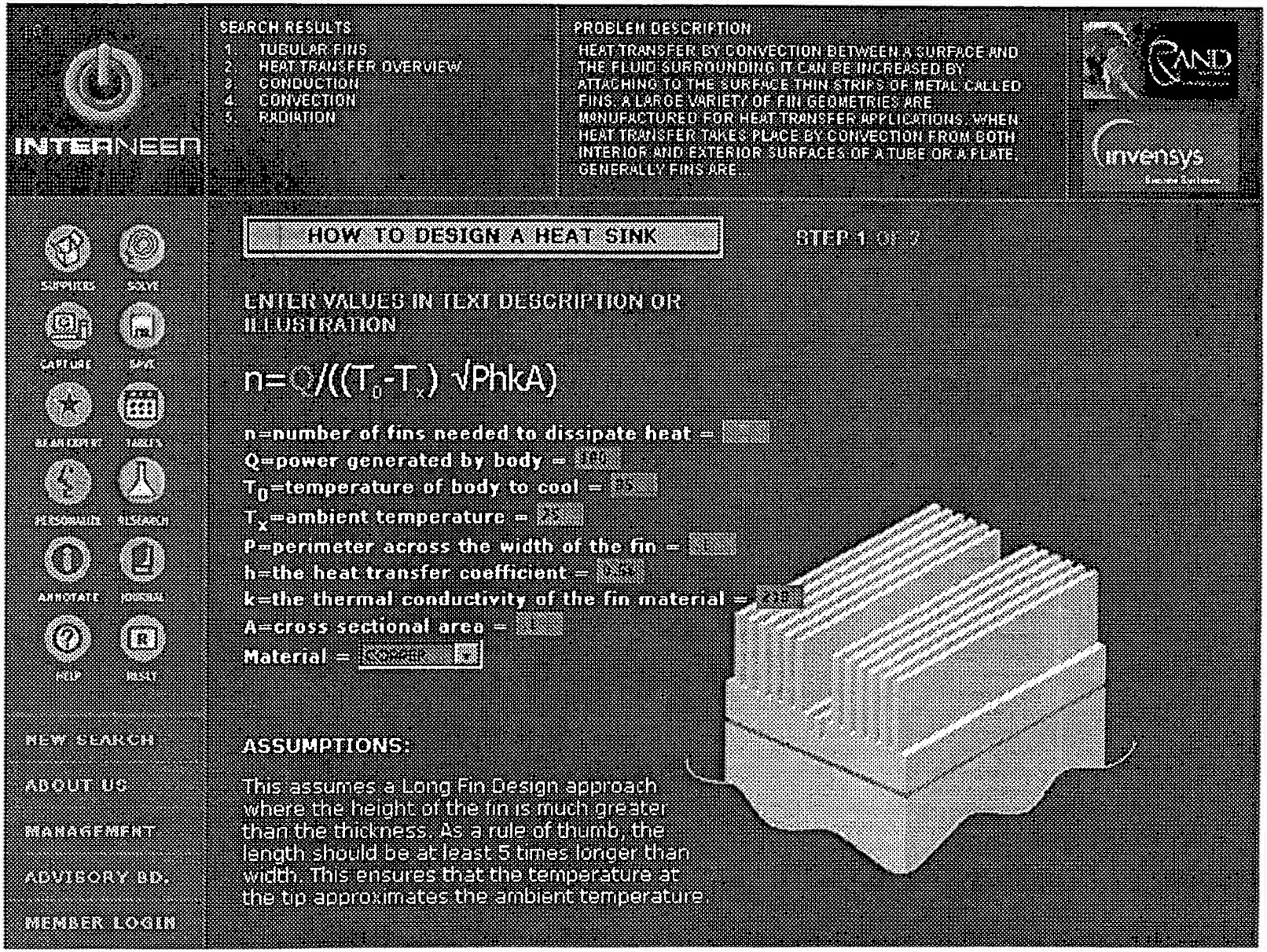
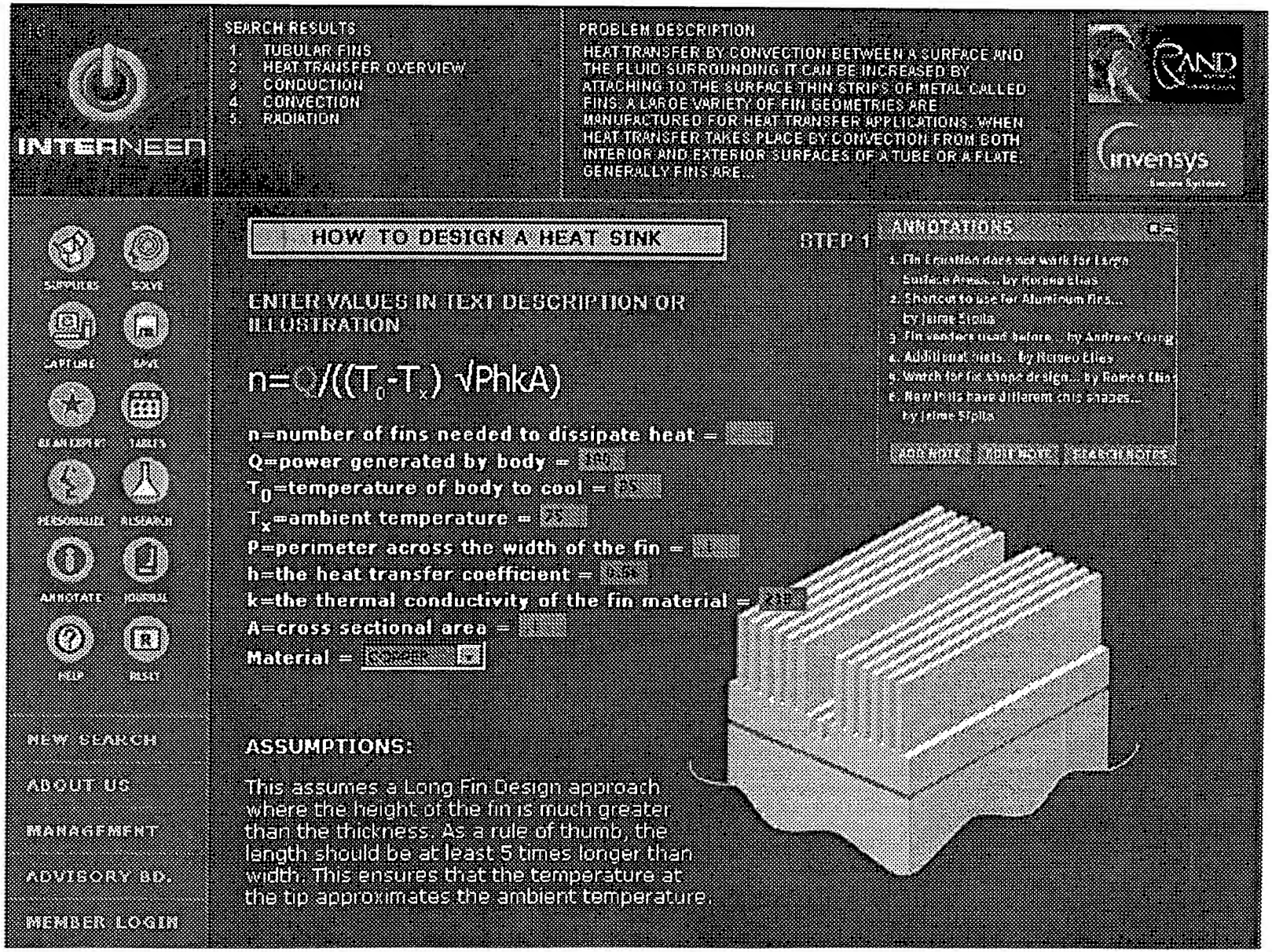

INTERNEEN
SEARCH RESULTS
1. TUBULAR FINS
2. HEAT TRANSFER OVERVIEW
3. CONDUCTION
4. CONVECTION
5. RADIATION
PROBLEM DESCRIPTION
HEAT TRANSFER BY CONVECTION BETWEEN A SURFACE AND THE FLUID SURROUNDING IT CAN BE INCREASED BY ATTACHING TO THE SURFACE THIN STRIPS OF METAL CALLED FINS. A LARGE VARIETY OF FIN GEOMETRIES ARE MANUFACTURED FOR HEAT TRANSFER APPLICATIONS. WHEN HEAT TRANSFER TAKES PLACE BY CONVECTION FROM BOTH INTERIOR AND EXTERIOR SURFACES OF A TUBE OR A PLATE, GENERALLY FINS ARE...
RAND
invensys
HOW TO DESIGN A HEAT SINK
STEP 1 OF 2
ENTER VALUES IN TEXT DESCRIPTION OR ILLUSTRATION
$n=Q/((T_0-T_x)\sqrt{PhkA})$
n=number of fins needed to dissipate heat =
Q=power generated by body =
T_0=temperature of body to cool =
T_x=ambient temperature =
P=perimeter across the width of the fin =
h=the heat transfer coefficient =
k=the thermal conductivity of the fin material =
A=cross sectional area =
Material =
ASSUMPTIONS:
This assumes a Long Fin Design approach where the height of the fin is much greater than the thickness. As a rule of thumb, the length should be at least 5 times longer than width. This ensures that the temperature at the tip approximates the ambient temperature.
NEW SEARCH
ABOUT US
MANAGEMENT
ADVISORY BD.
MEMBER LOGIN

Figure 5


INTERNEEN
SEARCH RESULTS
1. TUBULAR FINS
2. HEAT TRANSFER OVERVIEW
3. CONDUCTION
4. CONVECTION
5. RADIATION
PROBLEM DESCRIPTION
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invensys
HOW TO DESIGN A HEAT SINK
STEP 1
ANNOTATIONS
ENTER VALUES IN TEXT DESCRIPTION OR ILLUSTRATION
$n=Q/((T_0-T_x)\sqrt{PhkA})$
n=number of fins needed to dissipate heat =
Q=power generated by body =
T_0=temperature of body to cool =
T_x=ambient temperature =
P=perimeter across the width of the fin =
h=the heat transfer coefficient =
k=the thermal conductivity of the fin material =
A=cross sectional area =
Material =
ASSUMPTIONS:
This assumes a Long Fin Design approach where the height of the fin is much greater than the thickness. As a rule of thumb, the length should be at least 5 times longer than width. This ensures that the temperature at the tip approximates the ambient temperature.
NEW SEARCH
ABOUT US
MANAGEMENT
ADVISORY BD.
MEMBER LOGIN

Figure 6

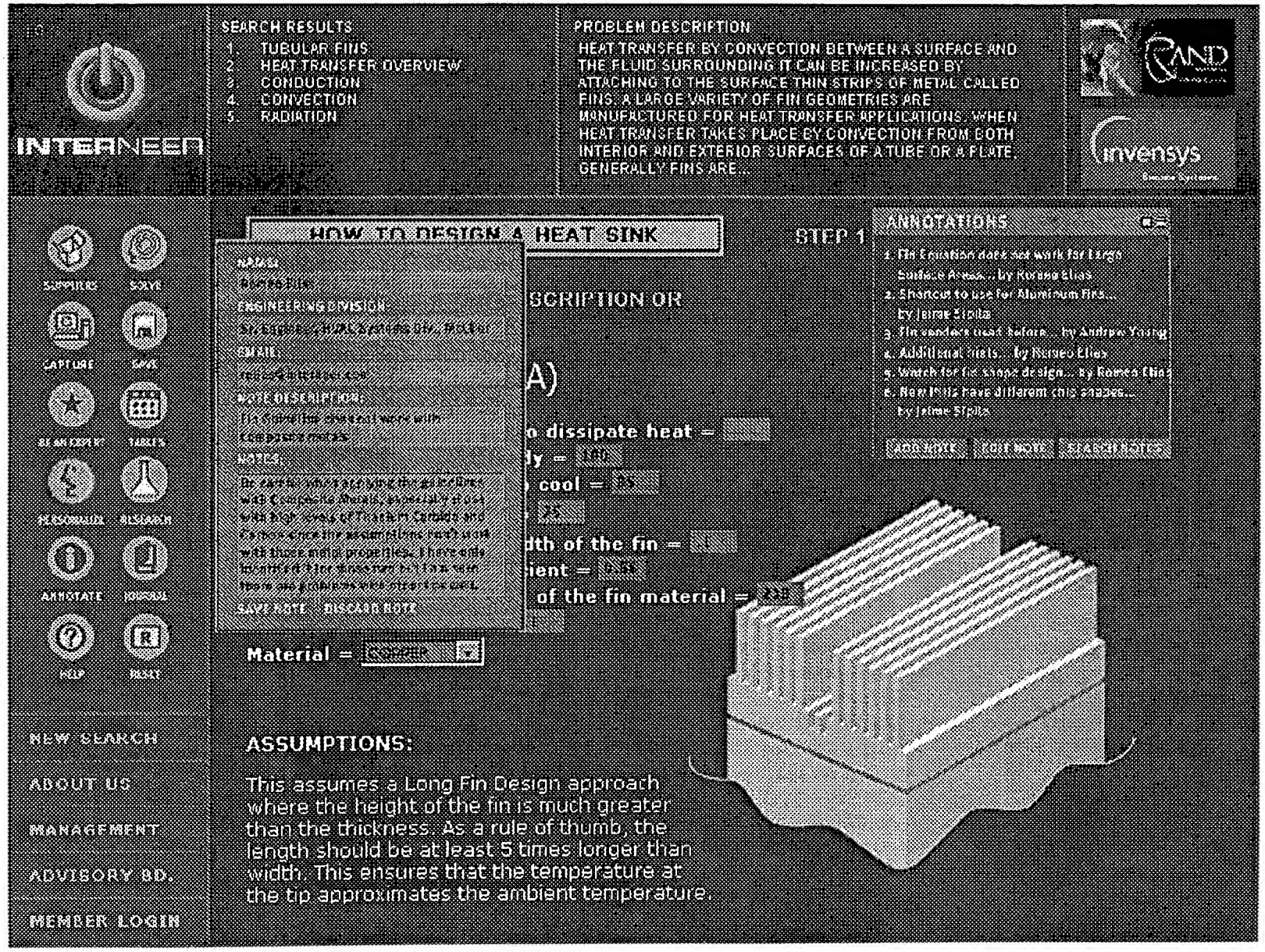

SEARCH RESULTS
1. TUBULAR FINS
2. HEAT TRANSFER OVERVIEW
3. CONDUCTION
4. CONVECTION
5. RADIATION
PROBLEM DESCRIPTION
HEAT TRANSFER BY CONVECTION BETWEEN A SURFACE AND THE FLUID SURROUNDING IT CAN BE INCREASED BY ATTACHING TO THE SURFACE THIN STRIPS OF METAL CALLED FINS. A LARGE VARIETY OF FIN GEOMETRIES ARE MANUFACTURED FOR HEAT TRANSFER APPLICATIONS. WHEN HEAT TRANSFER TAKES PLACE BY CONVECTION FROM BOTH INTERIOR AND EXTERIOR SURFACES OF A TUBE OR A PLATE, GENERALLY FINS ARE...
INTERNEER
HOW TO DESIGN A HEAT SINK
STEP 1
ANNOTATIONS
Material =
ASSUMPTIONS:
This assumes a Long Fin Design approach where the height of the fin is much greater than the thickness. As a rule of thumb, the length should be at least 5 times longer than width. This ensures that the temperature at the tip approximates the ambient temperature.
NEW SEARCH
ABOUT US
MANAGEMENT
ADVISORY BD.
MEMBER LOGIN

Figure 7

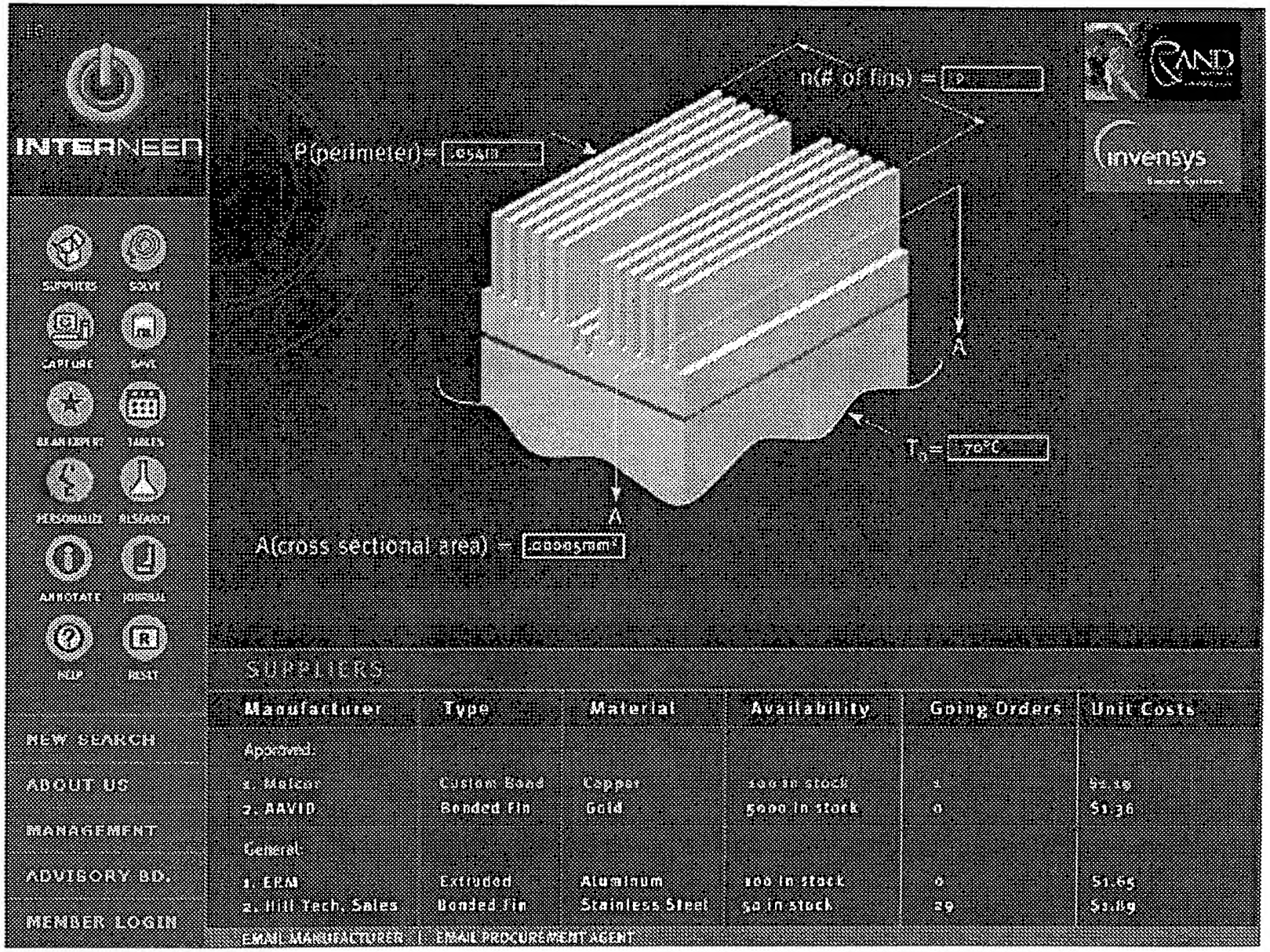

INTERNEEN
n(# of fins) =
P(perimeter) =
A
T_b =
A(cross sectional area) =
SUPPLIERS
Manufacturer
Type
Material
Availability
Going Orders
Unit Costs
Approved:
1. Melcor
Custom Board
Copper
2. AAVID
Bonded Fin
Gold
Good in stock
$1.36
General:
1. ERM
Extruded
Aluminum
100 in stock
$1.65
2. Hill Tech. Sales
Bonded Fin
Stainless Steel
50 in stock
39
$1.89
NEW SEARCH
ABOUT US
MANAGEMENT
ADVISORY BD.
MEMBER LOGIN
EMAIL MANUFACTURER
EMAIL PROCUREMENT AGENT

Figure 8

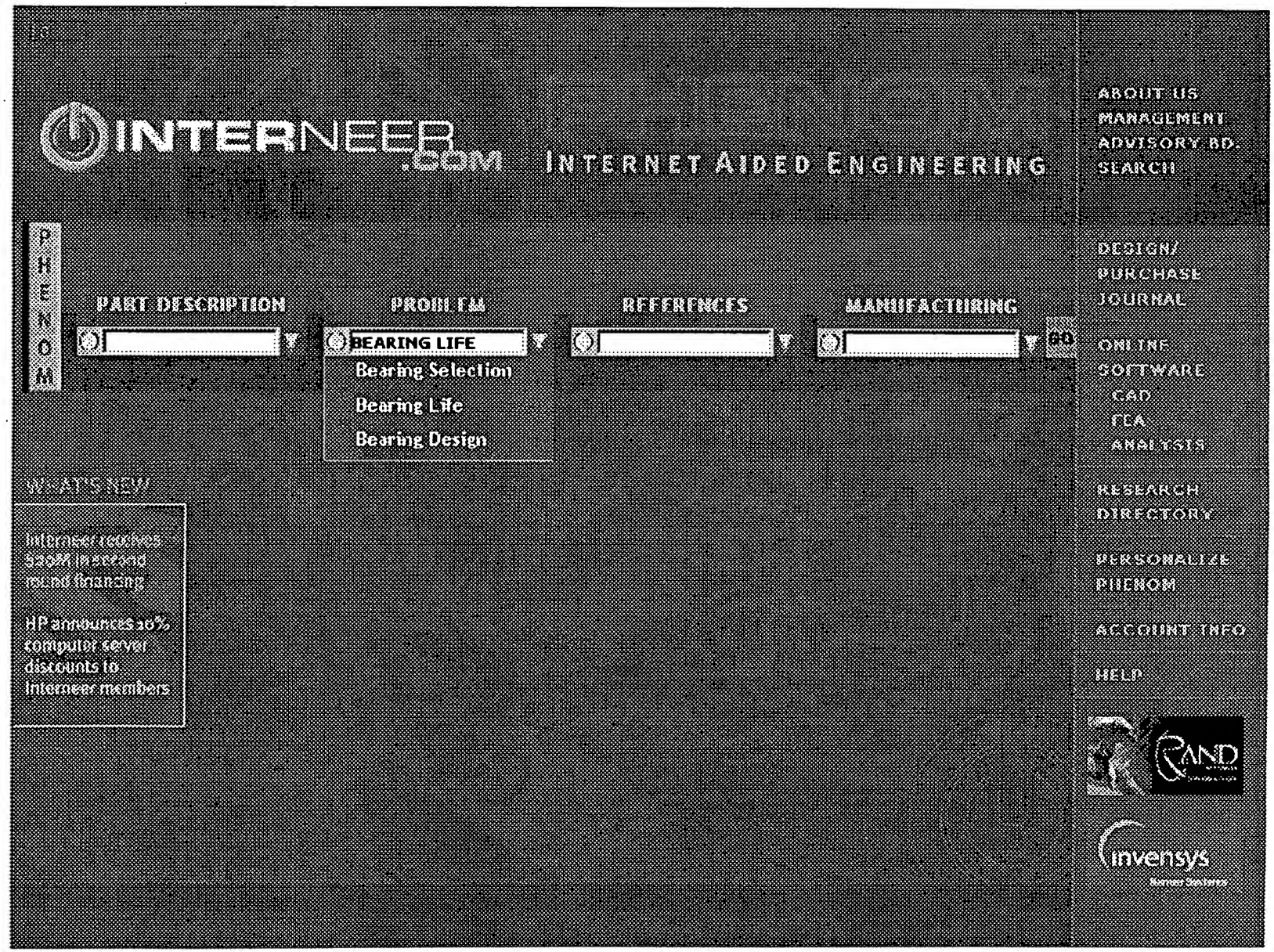

INTERNEER.COM
INTERNET AIDED ENGINEERING
PHENOM
PART DESCRIPTION
PROBLEM
REFERENCES
MANUFACTURING
GO
BEARING LIFE
Bearing Selection
Bearing Life
Bearing Design
WHAT'S NEW
Interneer receives $30M line and bond financing
HP announces 30% computer server discounts to Interneer members
ABOUT US
MANAGEMENT
ADVISORY BD.
SEARCH
DESIGN/ PURCHASE JOURNAL
ONLINE SOFTWARE
CAD
FEA
ANALYSIS
RESEARCH DIRECTORY
PERSONALIZE PHENOM
ACCOUNT INFO
HELP
RAND
invensys

Figure 9

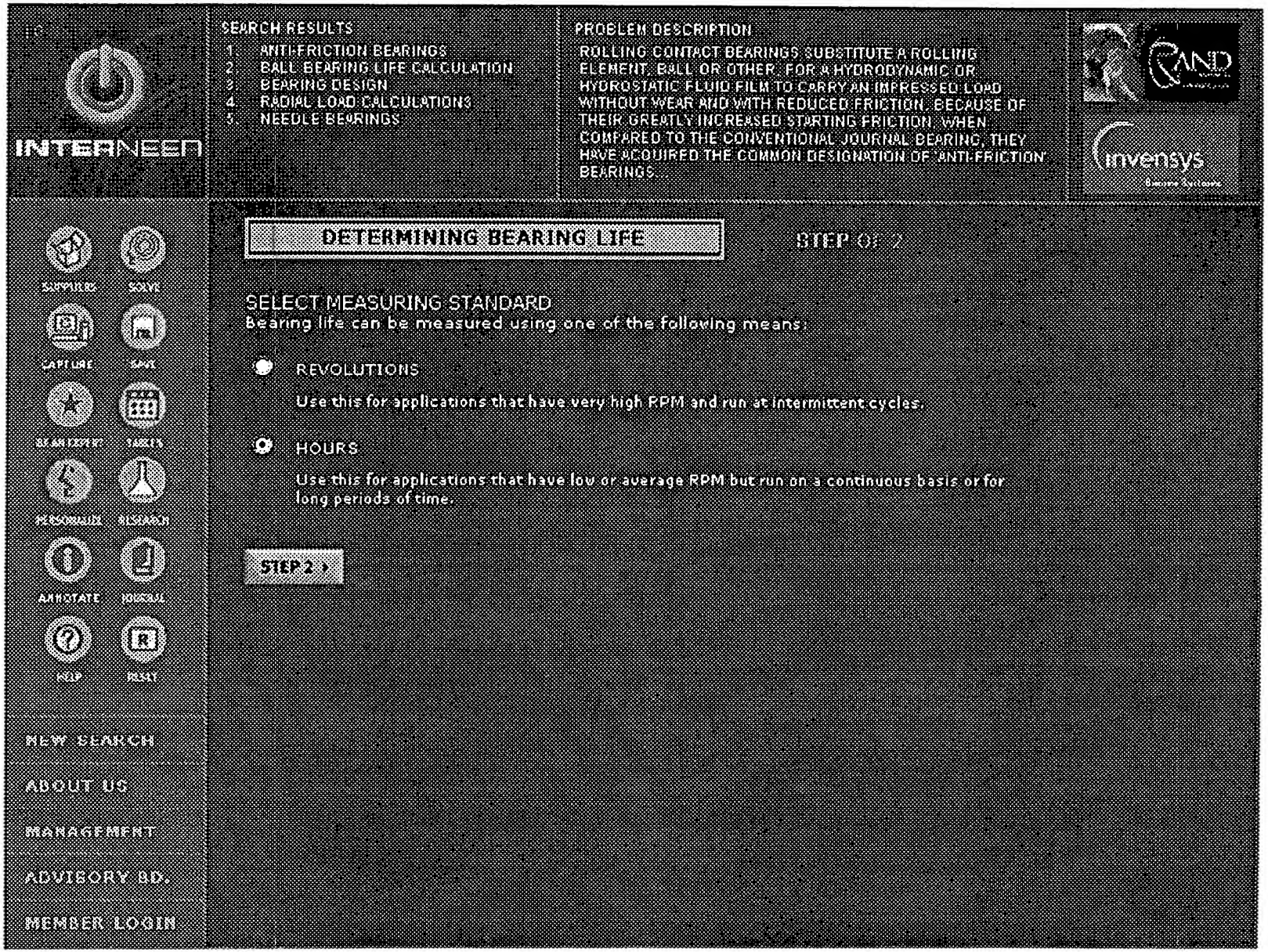
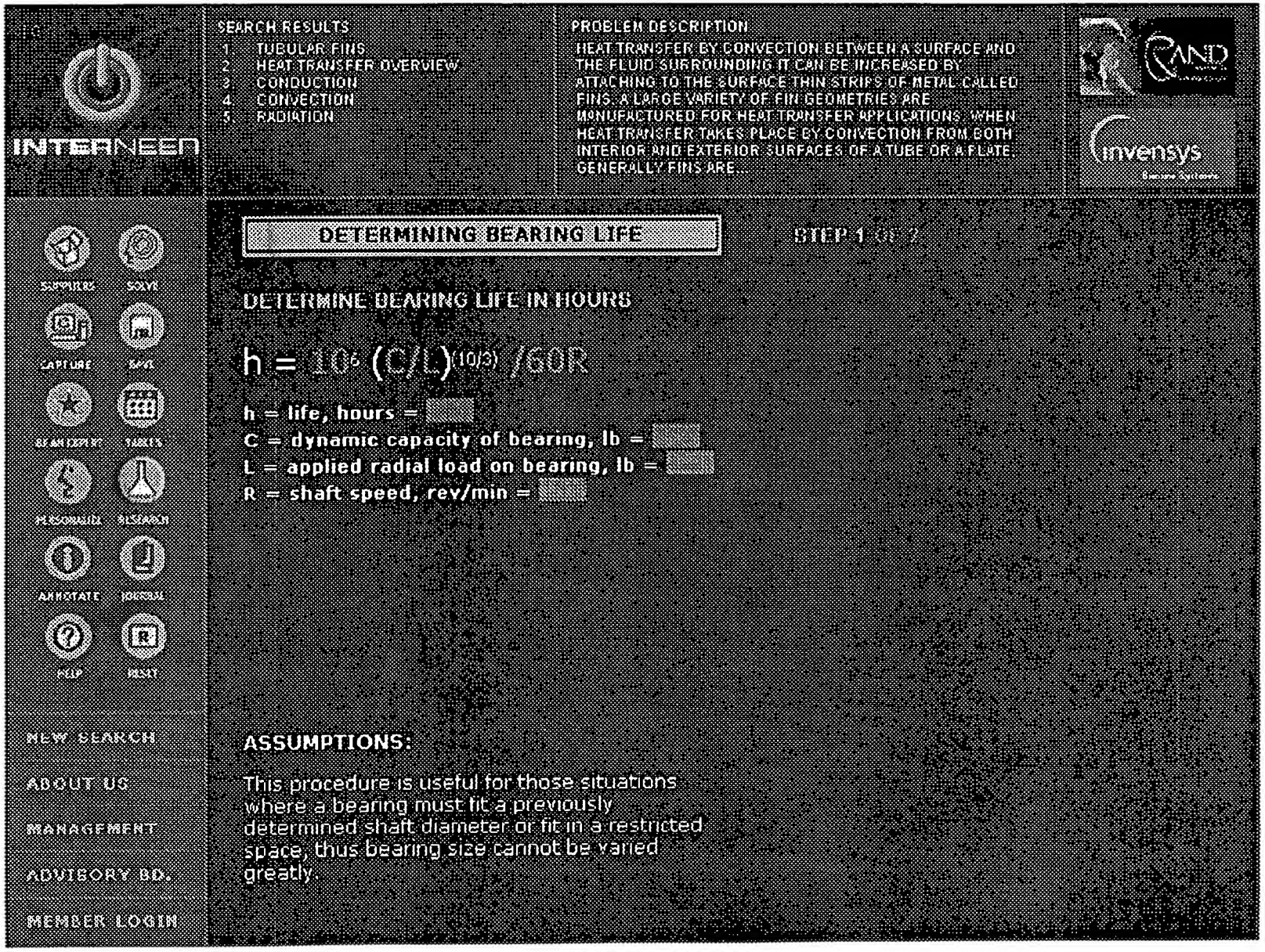

INTERNEEN
SEARCH RESULTS
1. ANTI-FRICTION BEARINGS
2. BALL BEARING LIFE CALCULATION
3. BEARING DESIGN
4. RADIAL LOAD CALCULATIONS
5. NEEDLE BEARINGS
PROBLEM DESCRIPTION
ROLLING CONTACT BEARINGS SUBSTITUTE A ROLLING ELEMENT, BALL OR OTHER, FOR A HYDRODYNAMIC OR HYDROSTATIC FLUID FILM TO CARRY AN IMPRESSED LOAD WITHOUT WEAR AND WITH REDUCED FRICTION. BECAUSE OF THEIR GREATLY INCREASED STARTING FRICTION, WHEN COMPARED TO THE CONVENTIONAL JOURNAL BEARING, THEY HAVE ACQUIRED THE COMMON DESIGNATION OF 'ANTI-FRICTION' BEARINGS.
RAND
invensys
DETERMINING BEARING LIFE
STEP 0F 2
SELECT MEASURING STANDARD
Bearing life can be measured using one of the following means:
REVOLUTIONS
Use this for applications that have very high RPM and run at intermittent cycles.
HOURS
Use this for applications that have low or average RPM but run on a continuous basis or for long periods of time.
STEP 2 ›
NEW SEARCH
ABOUT US
MANAGEMENT
ADVISORY BD.
MEMBER LOGIN

Figure 9A


INTERNEEN
SEARCH RESULTS
1 TUBULAR FINS
2 HEAT TRANSFER OVERVIEW
3 CONDUCTION
4 CONVECTION
5 RADIATION
PROBLEM DESCRIPTION
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RAND
invensys
DETERMINING BEARING LIFE
STEP 1 OF 2
DETERMINE BEARING LIFE IN HOURS
h = 10^6 (C/L)^(10/3) /60R
h = life, hours =
C = dynamic capacity of bearing, lb =
L = applied radial load on bearing, lb =
R = shaft speed, rev/min =
ASSUMPTIONS:
This procedure is useful for those situations where a bearing must fit a previously determined shaft diameter or fit in a restricted space, thus bearing size cannot be varied greatly.
SOLVE
CAPTURE
TABLES
RESEARCH
ANNOTATE
HELP
RESET
NEW SEARCH
ABOUT US
MANAGEMENT
ADVISORY BD.
MEMBER LOGIN

Figure 10

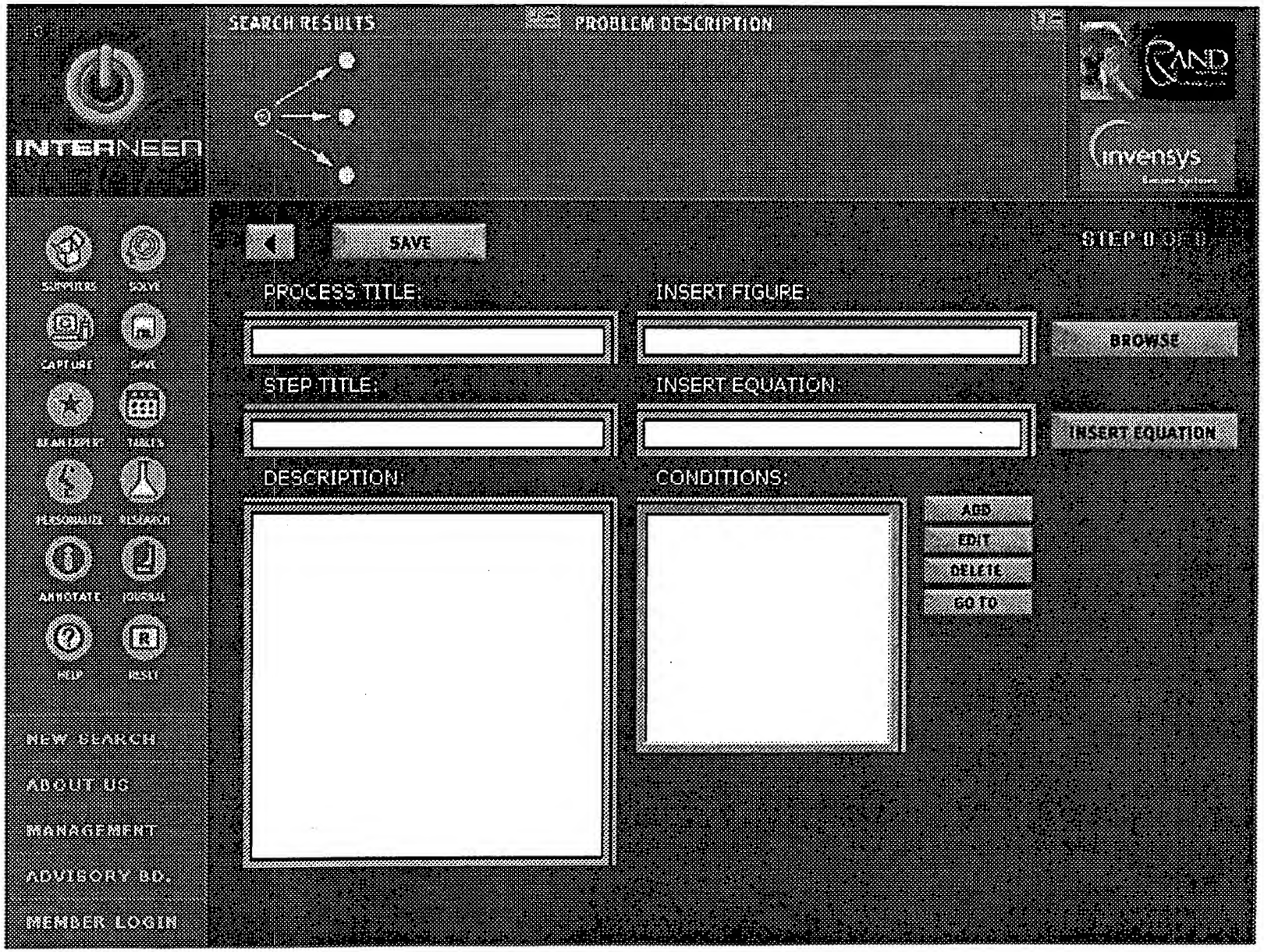
SEARCH RESULTS
PROBLEM DESCRIPTION
INTERNEER
RAND
invensys
SAVE
STEP 0 OF 0
PROCESS TITLE:
INSERT FIGURE:
BROWSE
STEP TITLE:
INSERT EQUATION:
INSERT EQUATION
DESCRIPTION:
CONDITIONS:
ADD
EDIT
DELETE
GO TO
SUPPORT
SOLVE
CAPTURE
SAVE
TOOLS
RESEARCH
ANNOTATE
HELP
RESET
NEW SEARCH
ABOUT US
MANAGEMENT
ADVISORY BD.
MEMBER LOGIN

Figure 11

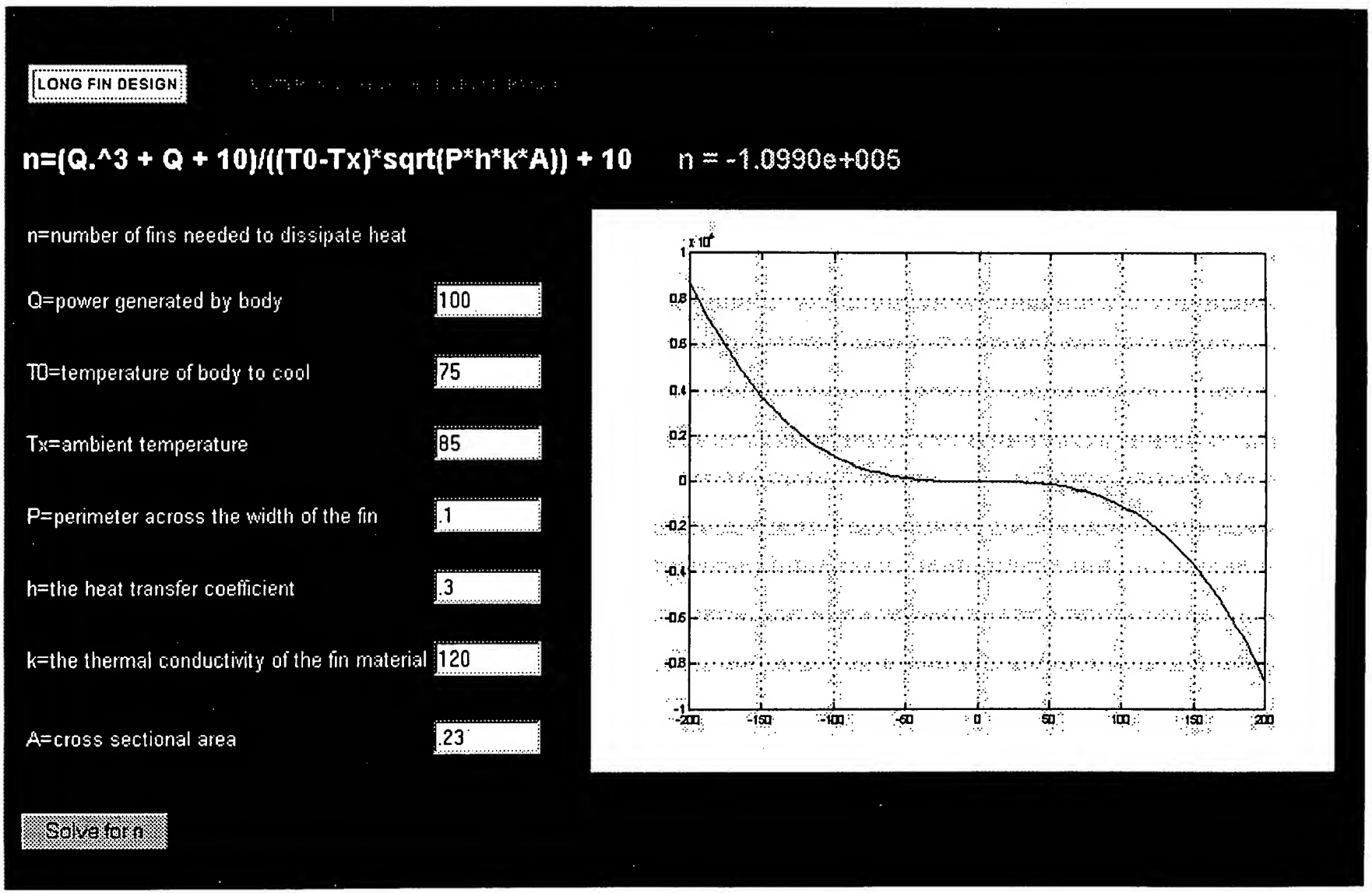
LONG FIN DESIGN
n=(Q.^3 + Q + 10)/((T0-Tx)*sqrt(P*h*k*A)) + 10
n = -1.0990e+005
n=number of fins needed to dissipate heat
Q=power generated by body
100
T0=temperature of body to cool
75
Tx=ambient temperature
85
P=perimeter across the width of the fin
.1
h=the heat transfer coefficient
.3
k=the thermal conductivity of the fin material
120
A=cross sectional area
.23
Solve for n
x 10^4
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-200
-150
-100
-50
0
50
100
150
200

Figure 12